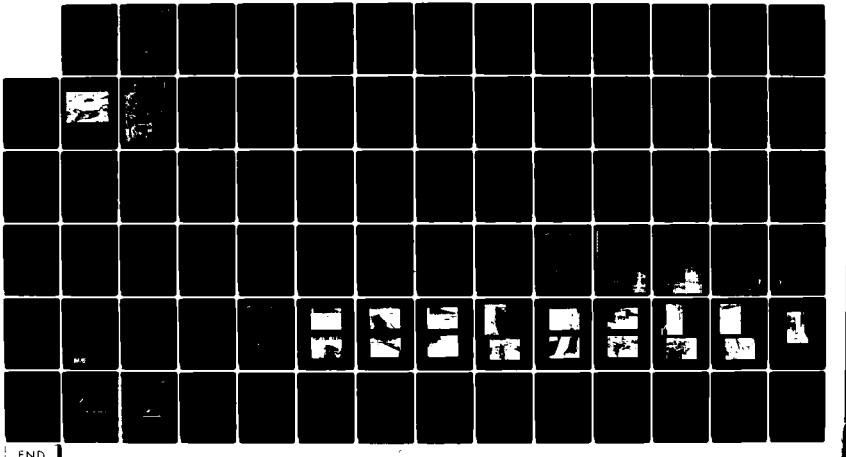
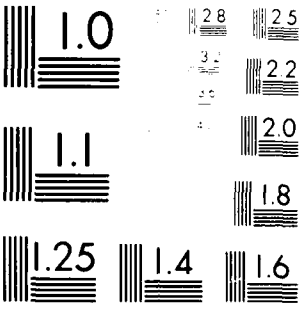
AD-A144 619 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 1/1
MYSTIC RESERVOIR-SOUT..(U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV FEB 81

UNCLASSIFIED F/G 13/13 NL



END
DATE FILMED
8-84
DTIC


1.0
2.8
2.5
3.2
2.2
2.0
1.1
1.8
1.25
1.4
1.6

CONNECTICUT COASTAL BASIN
STONINGTON, CONNECTICUT

MYSTIC RESERVOIR-SOUTH DAM

CT. 00613

AD-A144 619

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

FEBRUARY 1981

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CT 00613	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Mystic Reservoir-South Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE February 1981 13. NUMBER OF PAGES 55
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Connecticut Coastal Basin
Stonington, Connecticut

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Mystic Reservoir South dam is a 500 foot long combination earthfill and concrete gravity structure. The dam is classified as SMALL in size and a HIGH hazard structure. Based on the size and hazard classifications, the adopted test flood for this structure is equal to ½ the PMF. Based on a visual inspection at the site, the dam is considered to be in FAIR condition.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDED

MAY 2 9 1981

Honorable William A. O'Neill
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor O'Neill:

Inclosed is a copy of the Mystic Reservoir-South Dam (CT-00613) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, Connecticut-American Water Company, P.O., P.O. Box 219, Mystic, Connecticut 06355.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely,

C. E. EDGAR, III
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

MYSTIC RESERVOIR SOUTH DAM

CT 00613

CONNECTICUT COASTAL BASIN

STONINGTON, CONNECTICUT

PHASE 1 INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION REPORT

PHASE 1 INSPECTION REPORT

IDENTIFICATION NO:	CT 00613
NAME OF DAM:	Mystic Reservoir South Dam
COUNTY AND STATE:	New London County, Connecticut
STREAM:	Copps Brook
DATE OF INSPECTION:	19 November 1980

Brief Assessment

Mystic Reservoir South dam is a 500 foot long combination earthfill and concrete gravity structure. The earthfill section is 200 feet long, has a varying cross section, contains a concrete core wall, and has a crest width of 7 feet. The concrete gravity section is 300 feet long, has a varied cross section and contains the spillway. The spillway is made up of the main spillway and the emergency spillway. The main spillway is 50 feet long, has a crest elevation of 44.0 NGVD with 1 foot high flashboards, and is an ogee weir. The emergency spillway is also an ogee weir, is 75 feet long, and has a crest elevation 45.0 NGVD. The maximum height of the dam is 34 feet at the low level outlet. The low level outlet is a 24 inch diameter cast iron pipe controlled by a manually operated gate valve. The dam has a maximum impoundment capacity of 350 acre-feet at the top of dam elevation of 48.0 NGVD and is used for water supply. The water treatment facility is located at the toe of the dam.

The dam is classified as SMALL in size and a HIGH hazard structure in accordance with recommended guidelines established by the Corps of Engineers. Based on the size and hazard classifications, the adopted test flood for this structure is equal to one-half the Probable Maximum Flood (PMF) which is estimated to be 563 CSM, or 3,600 CFS, from the 6.4 square mile drainage basin. This test flood has a routed outflow discharge equal to 3,485 CFS and would overtop the dam by 0.2 feet. The maximum spillway capacity is equal to 3,080 CFS which represents 86% of the test flood outflow.

Based on a visual inspection at the site, the dam is considered to be in FAIR condition. However, these are several areas of concern which must be corrected to assure the long-term performance of this dam. It is recommended that the owner engage the services of a registered engineer experienced in the design of dams to accomplish the following:

1. Perform a detailed hydrologic/hydraulic investigation to assess further the need for and the means to increase project discharge capacity and the ability of the dam to withstand overtopping.

2. Recommend methods to rehabilitate the low level outlet to provide a means to draw down the reservoir for emergencies or for maintenance.

3. Investigate seepage into the well at the downstream toe of the embankment, at the toe of the spillway, and at concrete gravity section at Station 3+04.

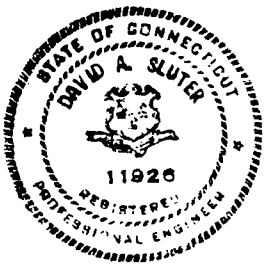
4. Investigate the cause of the depression located on the downstream slope of the embankment at Station 1+30 and its relationship to the seepage into the well.

5. Investigate and evaluate cracks and spalling of concrete on the intake structure, spillway toe and downstream face of the gravity section.

These and other recommendations and remedial measures as described in Section 7 should be implemented by the owner within one year after receipt of this Phase 1 Inspection Report.

NEW ENGLAND ENGINEERING, INC.

BY: David A. Sluter
David A. Sluter, P. E.
President



This Phase I Inspection Report on Mystic Reservoir-South Dam (CT-00613) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase 1 Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, DC 20314. The purpose of a Phase 1 Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase 1 investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with the data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

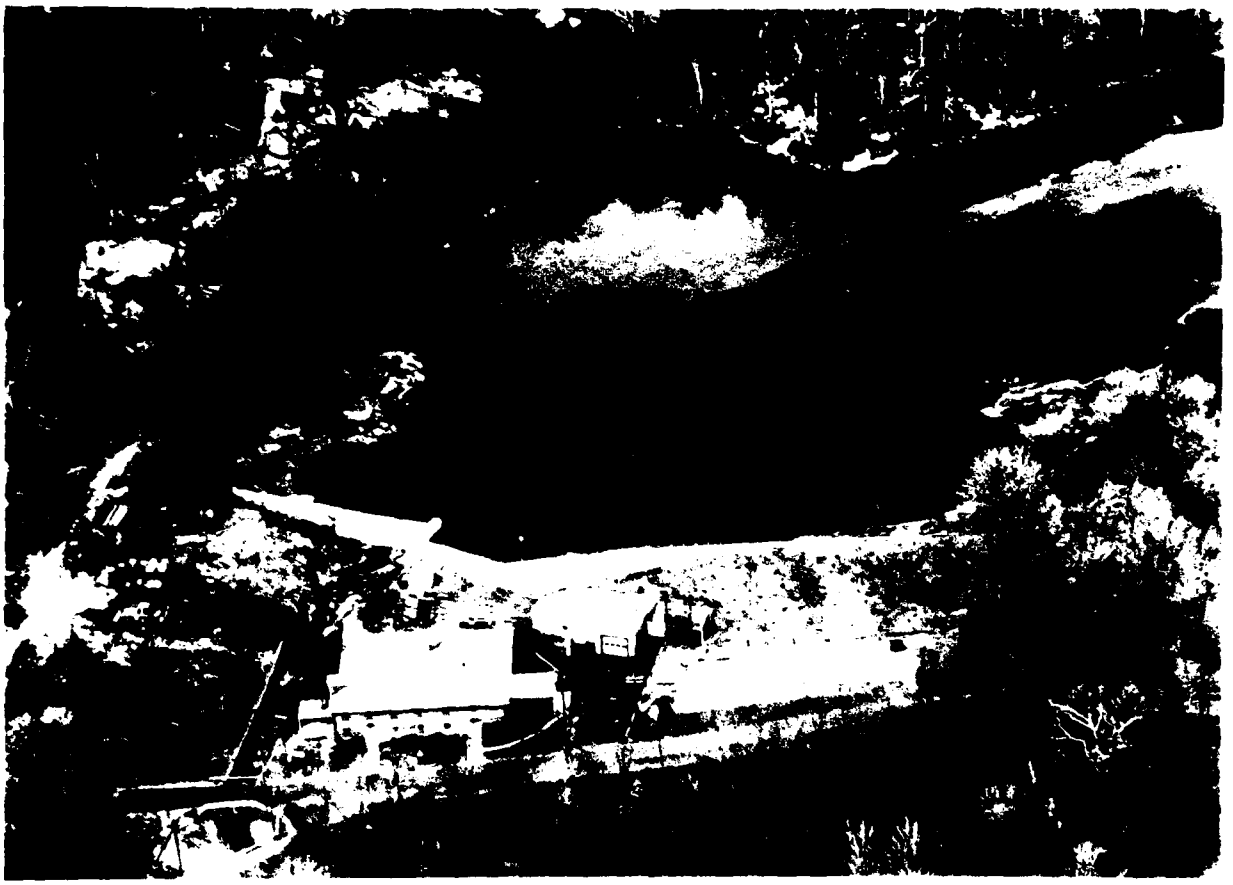
It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase 1 inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonable possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

The Phase 1 Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

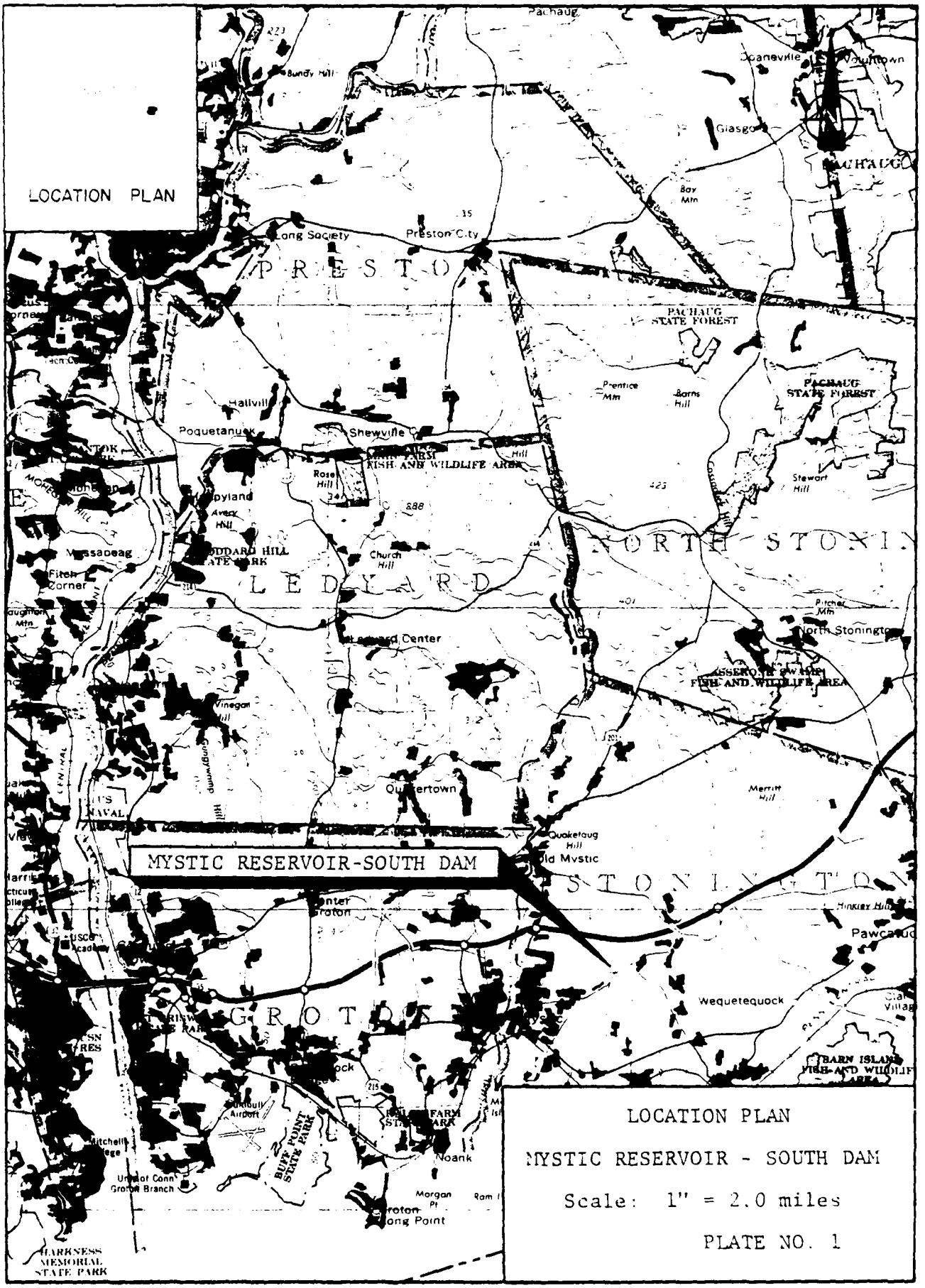
TABLE OF CONTENTS

APPENDICES



OVERVIEW PHOTO - Mystic Reservoir South Dam

December 12, 1980


LOCATION PLAN
MYSTIC RESERVOIR-SOUTH DAM
Pachaug
Bundy Hill
Oneco
Voluntown
Glasgo
Bay Mtn
Long Society
Preston City
PRESTON
PACHAUG STATE FOREST
Prentice Mtn
Barns Hill
Hallville
Poquetanuck
Shewville
Rose Hill
Stewart Hill
Church Hill
Fitch Corner
Pitcher Mtn
North Stonington
Ledyard Center
Vinegar Hill
Quaketaug Hill
Old Mystic
Merritt Hill
Pawcatuck
Wequetequock
Noank
Buff Point State Park
Morgan Pt
Groton Long Point
Harkness Memorial State Park
Barn Island Fish and Wildlife Area
LOCATION PLAN
MYSTIC RESERVOIR - SOUTH DAM
Scale: 1" = 2.0 miles
PLATE NO. 1

NATIONAL DAM INSPECTION PROGRAM

PHASE 1 - INSPECTION PROGRAM

MYSTIC RESERVOIR SOUTH DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army through the Corps of Engineers to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. New England Engineering, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to New England Engineering, Inc. under a letter from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-81-C-0007 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection.

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and assist the State to initiate quickly effective dam safety programs for non-Federal dams.

3. To update, verify, and complete the National Inventory of Dams.

1.2 Description of the Project

a. Location. Mystic Reservoir South Dam is located in Stonington, New London County, Connecticut on Copps Brook approximately 4,000 feet north of the mouth of the brook at Quiambog Cove. Coordinates of the dam are approximately 41 degrees, 21.9' North Latitude, and 72 degrees, 56.1' West Longitude as shown on the Mystic USGS Quadrangle Sheet. The dam impounds water from Copps Brook which drains a 6.4 square mile watershed of rolling, wooded terrain. The axis of the reservoir is oriented in a North-South direction with the dam at the southern extremity of the reservoir.

b. Description of Dam and Appurtenances. Mystic Reservoir South Dam is approximately 500 feet long including the spillway with a maximum height of 34 feet. The dam is a combination concrete gravity and earthfill structure founded on bedrock. The gravity section has vertical upstream and downstream faces, is 300 feet long, and includes a 125 foot long concrete ogee spillway. The spillway is divided into two sections with the main spillway having a length of 50 feet and a crest elevation of 44.0 NGVD which is one foot lower than the emergency spillway. One foot high flashboards are used on the main spillway to maintain a uniform crest elevation of 45.0 NGVD. The emergency spillway is 75 feet long. The earthfill section of the dam is 200 feet long and contains a concrete core wall which extends from the crest to bedrock below. The earthfill section is divided into two segments. The first segment extends from station 0+00 (18 feet left of the left abutment) to station 1+10 and has an upstream slope of 2.5:1 and a downstream slope of 2:1. The core wall for this segment is a diaphragm type and is 1 foot thick. The second segment of the earthfill section extends from 1+10 to 2+00 and has earthfill on the downstream side with a slope of 2:1. The core wall for this segment is a concrete gravity type and has a 5 foot top width, a vertical upstream face and a 1:5 downstream face.

The raw water intake structure and low level outlet are located near the centerline of the dam. Manually operated gates at this intake/outlet structure control the flow to the water treatment facility as well as the flow through the low level outlet. The low level outlet consists of a 24 inch diameter cast iron pipe which discharges into the former pumping station wet well in the wheelhouse at the toe of the dam. A six foot wide by 3 foot high rectangular tailrace carries the flow from the outlet to Copps Brook at the south side of Jerry Browne Road approximately 200 feet downstream of the dam.

c. Size Classification. This dam has an impoundment capacity of 350 Ac-Ft at the top of the dam (elevation 48.0 NGVD) and a maximum height of 34 feet. In accordance with the guidelines established by the Corps of Engineers, this dam is classified as SMALL in size based on its height and impoundment capacity. Corps of Engineers guidelines specify that dams with impoundment capacities less than 1,000 Ac-Ft and greater than or equal to 50 Ac-Ft or a height of less than 40 feet and greater than or equal to 25 feet be classified as SMALL in size.

d. Hazard Classification. This dam is classified a HIGH hazard potential because its failure could result in a loss of more than a few lives and inundation of the water treatment facility and wheelhouse at the toe of the dam. It is estimated that a dam failure discharge of 14,500 CFS could produce a depth of flooding of 12-15 feet in the wheelhouse and 4-6 feet in the water treatment facility. The dam failure discharge was computed assuming the water level in the reservoir to be equal to the top of dam elevation of 48.0 NGVD at the time of failure. There would be no inundation of the wheelhouse on the water treatment facility at the prefailure discharge of 2,600 CFS (with the outlet open). In addition, four bridges located downstream of the dam would be subject to damage from flooding as a result of a dam failure.

e. Ownership. The dam is presently owned by the Connecticut-American Water Company, P. O. Box 219, Mystic, Connecticut.

f. Operator. The dam and gates are operated by the Connecticut-American Water Company: Mr. David Kanke, District Manager, Connecticut-American Water Company, P. O. Box 219, Mystic, Connecticut 06355. Phone number (203) 536-9679.

g. Purpose of the Dam. The dam is used for water supply.

h. Design and Construction History. Mystic Reservoir South Dam was originally constructed in the late 1800's as a rubble masonry dam founded on bedrock and natural ground. In 1929, the dam was reconstructed, lengthened and raised to increase impoundment capacity. Plan, elevation and section drawings of the dam prepared by Vaughan Engineers are included in Appendix B. Training walls shown on these plans at the left and right spillway abutments were never constructed. The plans also call for stone riprap on the earth embankment section to the crest of the dam. Riprap on the upstream face extends only to within 3 feet of the crest.

The left side of the new dam from Station 0+18 to 1+10 consists of an earth embankment with a concrete diaphragm core wall tied into bedrock below the crest and at the left abutment. The central part of the dam from Station 1+10 to 2+00 consists of a concrete gravity section with an earth embankment on the downstream face, and includes the intake/outlet structure. The right side of the dam from Station 2+00 to 5+20 consists of a concrete gravity section and includes the spillway. The concrete gravity section from Station 2+00 to 5+20 is founded on gneiss bedrock that is locally weathered and fractured. The original dam was located between Station 2+00 and 3+00.

i. Normal Operating Procedures. The level of the reservoir is not normally controlled. Average water demands of 1.5 MGD to 3.5 MGD are diverted to the water treatment facility and the excess is allowed to flow over the spillway.

1.3 Pertinent Data

a. Drainage Area. The Mystic Reservoir South Dam drainage basin is rectangular in shape with an average length of approximately 4.5 miles, a width of 1.5 miles and a total drainage area of 6.4 square miles (See Appendix D for the basin map). Approximately 10 percent of the basin is man-made or natural storage. The topography consists of rolling terrain with elevations ranging from a high of 310 feet to 45 feet at the spillway crest. Basin slopes are considered moderate.

b. Discharge at Damsite. There are no discharge records available for this dam. Calculated discharge data for the dam is listed below.

1. Outlet Works

Conduit & Size	24 inch diameter cast iron pipe. Invert = 22.9 feet NGVD.
Discharge Capacity with reservoir at spillway crest elevation = 44.0	70 CFS
Discharge Capacity with reservoir at top of dam elevation = 48.0	75 CFS
Discharge Capacity at test flood elevation = 48.2	75 CFS
2. Maximum known flood at damsite	Unknown
3. Ungated spillway capacity at top of dam	3,080 CFS
4. Ungated spillway capacity at test flood elevation	3,350 CFS
5. Gated spillway capacity at normal pool elevation	N/A
6. Gated spillway capacity at test flood elevation	N/A

7.	Total spillway capacity at test flood elevation	3,350 CFS
8.	Total project discharge at top of dam	3,155 CFS
9.	Total project discharge at test flood elevation	3,485 CFS

c. Elevations (NGVD)

1.	Streambed at toe of dam	14.0
2.	Bottom of cutoff	Unknown
3.	Maximum tailwater	Unknown
4.	Normal pool	45.0
5.	Full flood control pool	N/A
6.	Spillway crest	
	a. Main spillway	44.0 without flashboards; 45.0 with flashboards.
	b. Emergency spillway	45.0
7.	Design surcharge (Original Design)	Unknown
8.	Top of dam	48.0
9.	Test flood	48.2

d. Reservoir Lengths (in feet)

1.	Normal pool	3,000
2.	Flood control pool	N/A
3.	Spillway crest pool	3,000
4.	Top of dam	3,000
5.	Test flood pool	3,000

e. Storage (acre-feet)

1.	Normal pool	250
2.	Flood control pool	N/A
3.	Spillway crest pool	250
4.	Top of dam	350
5.	Test flood pool	390

f.	Reservoir Surface Area (Acres)		
	1.	Normal pool	25
	2.	Flood control pool	N/A
	3.	Spillway crest	25
	4.	Top of dam	25
	5.	Test flood pool	25
g.	Dam		
	1.	Type	Gravity/Earth embankment
	2.	Length	500 feet
	3.	Height	34 feet maximum
	4.	Top width	
		a. Gravity Section	7 feet
		b. Earth Embankment	7 feet
	5.	Side slopes	
		a. Gravity Section	N/A
		b. Earth Embankment	2.5:1 U/S; 2:1 D/S
	6.	Zoning	None
	7.	Impervious Core	Concrete diaphragm core wall station 0+18 to 1+10 concrete gravity core wall 1+10 to 2+00
	8.	Cutoff	Extension of core wall and gravity section 1.5 feet into bedrock
	9.	Grout Curtain	Unknown
	10.	Other	Abutments are bedrock.
h.	Diversion and Regulating Tunnel		N/A
i.	Spillway		
	1.	Type	
		a. Main spillway	Ogee weir with 1.0 foot wood flashboards.
		b. Emergency spillway	Ogee weir.

2.	Length of Weir	
	a. Main spillway	50.0 feet
	b. Emergency spillway	75.0 feet
3.	Crest Elevation	
	a. Main spillway	44.0 feet
	b. Emergency spillway	45.0 feet
4.	Gates	None
5.	U/S Channels	Natural bed of reservoir
6.	D/S Channel	Bedrock discharge channel
7.	General	D/S channel passes under a roadway bridge 300 feet downstream

j. Regulating Outlet

1.	Invert	22.9 feet
2.	Size	24 inch diameter pipe
3.	Description	Cast iron pipe
4.	Control mechanism	Manually operated vertical lift gate
5.	Other	Discharges to 6 foot by 3 foot rectangular tailrace

SECTION 2

ENGINEERING DATA

2.1 Design

There is no available documentation regarding the design of this facility.

2.2 Construction

No records of the original dam construction are available. Construction drawings for the raising and reconstruction of the dam in 1929 are included in Appendix B. A report on leakage, structural and hydrologic investigations by Metcalf & Eddy, Inc. was submitted to the owner in June 1978. Thirteen subsurface borings were performed and four piezometers and five observation wells were installed as a part of this study. References for Metcalf and Eddy's report are contained in Appendix B of this report.

The borings showed that the foundation soil under the embankment portion of the dam is fine sand with a maximum thickness of 8 ft. Based on measurements by Metcalf & Eddy, the water level on the downstream side of the core wall at Station 0+58 was about 5 feet below the original ground surface and it remained below original ground all the way to the present downstream toe. The reservoir level at the time that these measurements were taken was elevation 45.0, 3 feet below the crest. The drop in head from the upstream to downstream side of the cutoff wall was 8 feet.

The borings by Metcalf & Eddy showed that the bedrock was gneiss that was locally weathered and fractured at least 10 feet below its surface. In particular, weathered bedrock was found just downstream from the concrete gravity section at Station 2+00 (upstream from the wheelhouse). The water level at this location in December 1977 was 3 feet below the bottom of the concrete gravity section (elevation 31.5). At that time, the reservoir level was 3 feet below the crest (elevation 45).

2.3 Operation

Records of daily water consumption and reservoir levels are maintained at the water treatment facility at the dam.

2.4 Evaluation

a. Availability. There is no design information available.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance and sound engineering judgement.

c. Validity. No design data is available.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The Phase 1 visual inspection of the Mystic Reservoir South Dam was conducted on November 19, 1980 by representatives of New England Engineering, Inc. and Geotechnical Engineers, Inc. A visual checklist and photographic record of that inspection have been included in Appendix A and C, respectively, of this report. At the time of the inspection, the water level was 3.8 feet below the spillway crest elevation of 45.0.

Based on the visual inspection, the dam is judged to be in FAIR condition.

b. Dam. The dam is a combination earth embankment and gravity structure approximately 500 feet in length with a maximum height of 34 feet. The earth embankment section contains concrete gravity and diaphragm core walls, has an upstream slope of 2.5:1, a downstream slope of 2:1, a crest width of 7 feet and a length of 190 feet. The gravity section of the dam has a crest width of 7 feet and is 310 feet long. The spillway is part of the gravity section of the dam, has a length of 125 feet and is located 75 feet from the right abutment. The intake/outlet works are located near the centerline of the dam and serve to control the flow to the water treatment facility located at the toe and to the 24 inch diameter low level outlet.

1. Upstream Face. The upstream face of the earth embankment section has 10-20 pound stone riprap protection to within 3 feet of the crest (Photo C-4). Small trees and brush cover the upstream slope from the riprap to the crest of the dam. The upstream face of the gravity section of the dam is vertical and spalling of the concrete in several places in vicinity of the normal pool level was observed (Photo C-3).

2. Crest. The crest of the dam is shown on Photos C-1, C-2, and C-3. The crest of the earth embankment section is 7 feet wide with the concrete core wall extending to the surface. The crest of the concrete gravity section has transverse hairline cracks spaced regularly 10-15 feet apart and at all construction key joints. Larger transverse cracks 1/32 to 1/16 inch were observed at Stations 2+50 and 2+95 (Photo C-9). Some spalling of a thin slush coat of concrete was observed on the crest

in the vicinity of the intake structure. The crest of the dam in the vicinity of the diaphragm core wall has settled 1 to 5 inches and the core wall has slight irregularities in its longitudinal alignment. These alignment irregularities appear to be the result of the original construction formwork for the concrete core wall.

3. Downstream Face and Toe. The downstream face and toe of the dam are shown in Photos C-5, C-6, C-7, C-8, C-10 and C-11. The downstream face of the earthfill section has regularly spaced tree stumps to 12 inches in diameter. They are conifers which were cut 5-10 years ago. The presence of the core wall in the dam, the low water levels in the downstream shell, the flat downstream slope and the fact that the roots of conifers are shallow all idicate that there is no need to remove the stumps. A 2 foot diameter stone wall has been built around a seepage area (Photo C-16) located at the toe at station 1+15. Approximately 4-5 gallons per minute of clear seepage was observed flowing through the well and into a 4 inch diameter PVC pipe which appeared to be tied into the parking lot storm drainage system. A shallow depression with lush grass growth, 4 feet in diameter and 6 inches deep is located at the toe at station 1+30. The depression was not wet at the time of inspection, however, it is possible that this area receives seepage when the water level is at a higher level. The cause of this depression should be investigated to determine its relationship with the seepage into the well. The downstream slope of the embankment is uneven, probably due to frost action, and a footpath has been eroded into the slope in the vicinity of Station 1+30. The downstream face of the concrete gravity section was spalled and cracked along its entire length. Extensive spalling, cracking and efflorescence of the concrete were observed on the downstream face at the intake/outlet structure as seen on Photo C-10. The holes in the downstream face seen in Photo C-10 are bore holes taken to obtain concrete samples during the investigation by Metcalf & Eddy, Inc. in 1978 (see Section 2.2). Approximately 1 foot of steel reinforcing bar was exposed at the angle point of this structure. Extensive spalling cracking and efflorescence are also evident at the toe and left abutment of the spillway (Photos C-7 and C-11). Clear seepage totalling 1-2 gallons per minute was observed at a crack at the left spillway abutment and the entire bedrock contact at the toe of the spillway (Photos C-7 and C-11).

An extensive wet area was observed 100 feet downstream from the toe of the embankment at the left abutment. No flowing seepage was observed at the time of inspection. The presence of a stream channel

leading from a field left of the dam to a culvert downstream from the wet area indicates that this portion of the left abutment probably receives drainage from the field.

c. Appurtenant Structures. Locations of the appurtenant structures are shown on the General Plan in Appendix B.

1. Spillway. The spillway is divided into two sections and is located 75 feet left of the left abutment. The main spillway has a crest elevation of 44.0 feet NGVD, is 50 feet long and is equipped with flashboards which are one foot high and in good condition. The emergency spillway is 75 feet long, and has a crest elevation of 45.0 feet NGVD. Both sections of the spillway are ogee weirs.

The downstream face of the spillway is badly cracked and spalled up to 3 feet above the toe (Photo C-7). Seepage flowing at less than 1 gpm at the bedrock contact was observed along the entire spillway length. Seepage flowing at less than 1 gpm was also observed to weep from cracks in the bedrock discharge channel up to 50 feet downstream. The emergency spillway has a longitudinal hairline crack along the length of the crest of the weir. A discharge channel from the right section was never constructed during the dam reconstruction in 1929. Spillway overflows have since eroded the earth cover from the bedrock to form a narrow channel which parallels the toe of the spillway (Photo C-7). Spillway discharge capacity can be reduced by a high tailwater resulting from insufficient capacity in the discharge channel and should be investigated. The pipe shown in Photo C-7 is a piece of discarded pipe and is not connected to the dam.

2. Intake/Outlet Structure. The intake/outlet structure is located near the centerline of the dam and is shown on Photo C-14. Manually operated gates control low level, intermediate and high level intakes to the wet well for raw water intake. Two outlets consisting of 12 inch and 16 inch diameter cast iron pipes carry raw water from the wet well to the water treatment facility and are controlled by manually operated gate valves. The 24 inch diameter low level outlet pipe is located to the right of the wet well and passes through the dam to the wheelhouse which formerly served as a raw water pumping station prior to the construction of the water treatment facility. The low level outlet discharges to what was once the pump pit for the pumping station. A 3 foot by 6 foot rectangular tailrace carries discharges to Copps Brook downstream of Jerry Browne Road.

The trash rack located at the entrance to the wet well is badly rusted and decayed as shown on Photo

C-13. The concrete slab which supports the intake valve lifting mechanism is cracked completely through and the concrete is spalled and cracked at the intake as shown on Photo C-13. According to the treatment plant operator, the low level intake valve and the low level outlet valve are inoperable. Seepage and efflorescence were observed on the stone masonry walls of the former pumping pit which forms the foundation for the wheelhouse (Photo C-17). Clear seepage flowing about 2-3 gpm was flowing from a joint in the right stone masonry wall.

d. Reservoir Area. No specific detrimental features in the reservoir area were observed during the visual inspection.

e. Downstream Channel. The downstream channel is bedrock with stone masonry training walls. The channel passes through two constricting culverts under Jerry Browne Road and Mistuxet Avenue, 300 feet and 350 feet respectively downstream from the dam. The channel contains brush, small trees and loose rock which act as restrictions to flow.

3.2 Evaluation

Based on the visual inspection, the dam appears to be in FAIR condition. The following features could adversely affect the future performance of the dam and should be investigated:

a. The inoperable low level outlet gate valve.

b. Seepage into the well at the downstream toe of the earth embankment and at the toe of the spillway.

c. The seepage through the walls of the wheelhouse pumping pit, at the toe of the dam.

d. The 4 foot diameter depression located at the toe at Station 1+30 and its relationship to the seepage into the well at Station 1+15.

e. Cracks and efflorescence on the downstream face of the concrete gravity section which may be evidence of seepage through the dam.

f. Cracks in the concrete intake structure.

g. The need for additional riprap on the upstream slope of the embankment.

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. Mystic Reservoir is used as a water supply which serves the Village of Mystic, CT. The dam is owned and operated by the Connecticut-American Water Company. An average demand of 2.5 to 3.5 MGD is drawn from the reservoir for water supply and excess is allowed to flow over the spillway. The reservoir level is generally not controlled, however, a daily record of the water level is recorded by the treatment facility operator. Flashboards on the spillway are normally kept in place to maintain a full pond at elevation 45.0 NGVD.

b. Warning System. There is no formal warning system or emergency action plan for the dam.

4.2 Maintenance Procedures

a. General. A regular maintenance staff is available at the dam to perform light maintenance as required.

b. Operating Facilities. According to the treatment facility operator, the low level outlet gate is not operable.

4.3 Evaluation

a. The facility receives only light maintenance such as painting and grass mowing. The intake and outlet gates are not operated or lubricated regularly. The low level outlet is inoperable and the reservoir level cannot be readily lowered for maintenance or in the event of an emergency.

b. Small trees and brush are growing on the upstream face of the earth embankment.

c. There is no regularly scheduled maintenance for this dam. There are numerous maintenance deficiencies as described above. A systematic inspection and rehabilitation program should be developed and implemented. The low level outlet gate should be rehabilitated so that the reservoir level may be regulated, if required.

d. An emergency action plan should also be developed and implemented that includes procedures to lower the reservoir level, locations of emergency equipment, materials or manpower to reduce or minimize dam failure damage, authorities to be contacted in emergency situations and a program of surveillance during unusual storm events.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The Mystic Reservoir South Dam was reportedly constructed in the late 1800's for water supply. The dam was reconstructed and raised in 1929. The dam is located on the Copps Brook in the Connecticut Coastal Basin. The watershed for the reservoir is 6.4 square miles with approximately 10% of this basin man-made or natural storage.

The dam has a spillway length of 125 feet and a maximum height of 34 feet. The total length of the dam is 500 feet including the spillway. The reservoir has a storage capacity at the spillway crest of 250 Ac-Ft. Each foot of depth above the spillway level can accommodate 25 Ac-Ft of water equivalent to 0.07 inches of runoff.

It will take about 4 hours to lower the reservoir 1 foot based on a surface area of 25 acres and an outflow of 75 CFS. For the 250 Ac-Ft of storage below the spillway it is estimated that it would take about 40 hours to drain the reservoir.

5.2 Design Data

Little specific data is available for this watershed or structure. In lieu of existing complete design information, U.S.G.S. topographic maps (scale 1" = 2,000') were utilized to develop hydrologic parameters such as drainage area, reservoir surface areas, basin slopes and other runoff characteristics. Elevation-storage relationships for the reservoir were approximated. Some of the pertinent hydraulic data was obtained or confirmed by actual field measurements at the time of the visual inspection. Test flood inflows and outflows and dam failure flows were determined in accordance with the Corps of Engineers guidelines.

5.3 Experience Data

No historical data for recorded discharges is available for this dam.

5.4 Test Flood Analysis

Recommended guidelines for the Safety Inspection of Dams by the Corps of Engineers were used for selection of the Test Flood. This dam is classified under those guidelines as a HIGH hazard and SMALL in size. Guidelines indicate that a flood equal to one-half the PMF to the full PMF be used as a range of test floods for such a classification. A test

flood equal to 1/2 the PMF was selected because the dam is on the low end of the size classification. The watershed has a total drainage area equal to 6.4 square miles of which approximately 10% is man-made or natural storage. This drainage area is sparsely populated, fairly wooded, with rolling topography.

A test flood value was selected from the Corps of Engineers PMF curve for a watershed with flat to rolling topography and reduced by 10% for storage within the watershed. The test flood inflow was calculated to be 563 CSM, equal to 3,600 CFS and was adopted for this analysis. The routed outflow discharge for the test flood inflow was 3,485 CFS. The spillway and outlet rating curves are illustrated in Appendix D. Flood routing was performed assuming a full reservoir at the spillway crest elevation of 44.0 NGVD and the outlet to be open. The flashboards on the main spillway were assumed to be removed.

The analysis indicated that the peak test flood outflow would overtop the dam by approximately 0.2 feet. The maximum outflow capacity of the spillway at the top of dam elevation 48.0 is 3,080 CFS with the flashboards removed or 86% of the test flood.

5.5 Dam Failure Analysis

For this analysis a full-depth, partial-width breach was assumed to have occurred in this dam. The adopted breach width of 36.0 feet was based on a maximum width of 40% of the dam length at mid height as recommended by the Corps of Engineers. A dam failure discharge of 14,500 CFS was calculated assuming the reservoir level to be at the top of dam elevation 48.0. The dam failure discharge of 14,500 CFS includes a spillway discharge of 2,500 CFS and will produce a depth of flooding of 15 feet at the toe of the dam. It is estimated that failure could result in the loss of more than a few lives and a flood wave with a depth of 4-6 feet at the treatment plant downstream of the dam. The wheelhouse located at the toe of the dam would be subject to a flood wave of approximately 12-15 feet in depth. Office facilities for the maintenance staff are located in both the treatment facility and in the wheelhouse. Two bridges over Copps Brook downstream of the dam are located within the failure impact area and would be subject to flood damage. The prime impact area that would be subject to damage if the dam were to fail has been delineated on the Dam Failure Impact Area Map in Appendix D. As a result of the failure analysis, the dam has been classified as a HIGH hazard structure.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

Visual examination of the geotechnical and structural aspects of the dam do not indicate any immediate stability problems. However, the following features could affect the long-term stability of the dam.

a. Seepage was observed emanating at the downstream toe in a 1.5 foot deep well at Station 1+15. Since the foundation soils seem to be "relatively pervious fine sands" this seepage could carry fines out of the foundation and cause distress of the downstream slope.

   The water level measurements indicate that the core wall is functioning since there was an 8 foot drop in head across it on the day of inspection. On the other hand, a small depression was noted upstream from the well at Station 1+30, and borings carried out by Metcalf & Eddy indicate that the gneiss bedrock is locally weathered and fractured. Both of these facts indicate that there may be some movement of fines occurring. It is therefore necessary to investigate this possibility and/or to monitor rate and turbidity of flow, as well as future settlement at the observed depression.

b. The absence of riprap on the upstream slope of the embankment should be checked, since it appears that the riprap originally designed was not placed.

6.2 Design and Construction Data

No design or construction drawings or records for the original dam are available.

6.3 Post-Construction Changes

According to a 1978 report prepared by Metcalf & Eddy, Inc. (Refer to Appendix B), the original Mystic Reservoir South Dam constructed during the late 1800's of rubble masonry walls, developed serious stability problems. The dam was reconstructed, lengthened and raised to its present configuration during the late 1920's. Design drawings of features of the reconstructed dam are shown in Appendix B. The borings carried out for the 1978 report provided information on subsurface materials and water levels, both of which were discussed in Sections 3.1(b) and 6.1.

6.4 Seismic Stability

The dam is located in Seismic Zone 1 and, in accordance with recommended Phase 1 guidelines, does not warrant seismic stability analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Based on the visual inspection, this dam is judged to be in FAIR condition. Features which could adversely affect the condition of the dam in the future are:

1. Seepage into the well at the downstream toe of the embankment and the depression located at Station 1+30.

2. Seepage through the wheelhouse foundation wall and cracks, spalling and seepage at the toe of the spillway and at the left abutment.

3. Cracking and spalling of concrete on the gravity section of the dam.

4. Lack of riprap on the upstream face above the normal pool elevation.

5. The inoperable low level outlet gate.

b. Adequacy of Information. The available information is such that the assessment of the condition of the dam must be based on visual observation.

c. Urgency. The recommendations and remedial measures described below should be implemented by the owner within one year after receipt of the Phase 1 report.

7.2 Recommendations

The following items should be carried out under the direction of a qualified registered engineer and recommendations resulting should be implemented by the owner.

a. Perform a detailed hydrologic/hydraulic investigation to assess further the need for and the means to increase project discharge capacity and the ability of the dam to withstand overtopping.

b. Investigate the source and extent of seepage from the well at Station 1+15. In particular, determine whether there is any movement of fines occurring, and whether the depression on the downstream slope at Station 1+30 is related to the observed seepage or other causes.

c. Investigate the cause of the inoperable low level outlet and repair as necessary.

d. Investigate and recommend methods to repair cracking and spalling of the concrete along the crest and at the downstream toe of the spillway, at the left spillway abutment on the downstream face of the gravity section of the dam, and at the intake/outlet structure. Investigate and recommend methods to control seepage through and beneath the spillway.

e. Evaluate the need for increasing the capacity of the spillway discharge channel.

f. Design and supervise the placement of riprap on the upstream face of the embankment between the normal pool elevation and the crest.

g. Replace the trash rack.

7.3 Remedial Measures

a. Operation and Maintenance Procedures.

1. Develop an "Emergency Action Plan" that will include an effective preplanned downstream warning system, locations of emergency equipment, materials and manpower, authorities to contact and potential areas that require evacuation.

2. Clear brush and trees on the upstream face of the embankment. Maintain clear by cutting at least annually.

3. Monitor seepage in sump of wheelhouse to detect rate and turbidity as a function of reservoir level. If changes occur, engage an engineer to evaluate the data and to make further recommendations.

4. Implement a regular maintenance program for the facility.

5. Institute a program of annual technical inspection by a qualified registered engineer.

6. Monitor the water levels in all observation walls on at least a monthly basis.

7. Fill the low area on the crest and the footpath on the downstream face with proper compacted material.

8. Establish protective grass cover over all bare areas.

7.4 Alternatives

There are no practical alternatives to the remedial measures discussed above.

APPENDIX A

INSPECTION CHECKLIST

1

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT MYSTIC RIVER BRIDGE - CT Rt. 1A

DATE Nov. 14, 1978

TIME 7:30 a.m.

WEATHER Clear, 41° F.

W.S. ELEV. 41.2 U.S. 32.6 DN.S.

PARTY:

1. David Sluter - New England Engineering
2. Stephen Fodor - New England Engineering
3. Steve J. Poulos - SGI
4. Robert E. Stothar - GFI
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Geotechnical	S. J. Poulos, R. E. Stothar	
2.	Civil & Structural	S. Fodor	
3.	Hydraulics & Hydrology	D. Sluter	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECKLIST

PROJECT [illegible] DATE [illegible]

PROJECT FEATURE Embankment - Civil NAME [illegible]

DISCIPLINE [illegible] NAME Sluter/Fodor

AREA EVALUATED	CONDITION
DAM EMBANKMENT	Zero for stationing is the left end of the concrete [illegible] wall where it meets rock abutment.
Crest Elevation	48.0
Current Pool Elevation	41.2
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed.
Pavement Condition	N.A.
Movement or Settlement of Crest	[illegible] slightly irregular vertically and horizontally. Appears to have been built that way. Crest of embankment is 1 to 5 in. below top of core wall.
Lateral Movement	No movement observed.
Vertical Alignment	No misalignment observed. See item [illegible].
Horizontal Alignment	Core wall has [illegible] bend at about Sta. [illegible]+75. About 1 in. out of line.
Condition at Abutment and at Concrete Structures	Satisfactory.
Indications of Movement of Structural Items on Slopes	N.A.
Trespassing on Slopes	Tree [illegible]. Path at Sta 1+[illegible] is [illegible] wide, up to 1[illegible] in. deep, passes from crest to toe.
Sloughing or Erosion of Slopes or Abutments	Downstream slope - [illegible]. Upstream slope - none observed.
Rock Slope Protection - Riprap Failures	[illegible] riprap [illegible] ft below crest. No filter evident; satisfactory condition.
Unusual Movement or Cracking at or Near Toe	None observed.
Unusual Embankment or Downstream Seepage	Downstream toe at left abutment: Wet area due in part to drainage from farmer's field far to the left. Could be some seepage through abutment also. No flowing seepage observed. Downstream toe Sta 1+15: Streamlet in bottom of 2-ft-diameter stone well about 1.5 ft below grade, running clear at [illegible]4 gpm and probably drained with a pipe to a storm sewer. [illegible] at bottom. A hole extends upstream into dam 2.5 ft from well. See [illegible].

PERIODIC INSPECTION CHECKLIST

PROJECT [illegible] DATE [illegible]

PROJECT FEATURE Embankment - Civil NAME [illegible]

DISCIPLINE [illegible] NAME Sluter/Fodor

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Unusual Embankment or Downstream Seepage (con't. from page 2)	[illegible] flowing water. Downstream toe at Sta 1+50: 4 ft diameter dry [illegible] area of lush grass with lots of cattails extending from toe downstream to the left. No seepage. See sketch. Downstream toe of spillway at right angle, at Sta 3+ 4, to end of spillway: Clear seepage and wetness, extending 3 ft. Appears to be at contact between [illegible] and bedrock. Flowing dye from joint between left end of spillway and concrete gravity dam, about 1 ft above toe elevation.
Piping or Boils	None observed.
Foundation Drainage Features	None observed.
Toe Drains	None observed.
Instrumentation System	See list of wells on page 1B.
Vegetation	Downstream slope: Grass with pine stumps about 5 years old cut [illegible] yr. to [illegible] ground, spaced 6 to 15 ft apart. Upstream slope, left side: Low brush.

PERIODIC INSPECTION CHECKLIST

MYSTIC RIVER [illegible] [illegible] [illegible] Nov. [illegible], 198[illegible]

List of Observation Wells

Station	Downstream Offset from Centerline (ft)	Composition of Riser
[illegible]	[illegible]	Steel
	[illegible]	Steel
	[illegible]	P.V.C.
	[illegible]	P.V.C.
[illegible]	[illegible]	P.V.C.
[illegible]	[illegible]	P.V.C.
[illegible]	[illegible]	Steel
[illegible]	[illegible]	P.V.C.

GEOTECHNICAL ENGINEERS INC

PERIODIC INSPECTION CHECKLIST

PROJECT [illegible] DATE [illegible]

PROJECT FEATURE Embankment - Civil NAME Foster Sluter

DISCIPLINE Geotechnical NAME Sluter/Foder

AREA EVALUATED	CONDITION
CONCRETE GRAVITY PORTION	
Crest Elevation	48.0
Current Pool Elevation	41.2
Maximum Impoundment to Date	Unknown
Surface Cracks	Hairline cracks cross through all construction keys in crest. Transverse hairline cracks spaced regularly [illegible] ft apart. Cracks at Sta 2+5 and 3+14 are [illegible] in. wide.
Pavement Condition	Walkway on crest of concrete gravity portion in good condition.
Movement or Settlement of Crest	None observed.
Lateral Movement	None observed.
Vertical Alignment	Satisfactory.
Horizontal Alignment	Satisfactory.
Condition at Interface with Earth Portion and at Left Abutment	Satisfactory.
General Condition of Concrete	Fair.
Rust or Staining	Rusty staining at Sta 3+14 from about 4 ft below crest and below.
Spalling and Efflorescence	Downstream face, entire length, from about 4 ft below crest and below.
Any Visible Reinforcing	None.
Seepage	See page 2A.
Piping or Boils	None observed.
Foundation Drainage Features	None observed.
Toe Drains	None observed.
Instrumentation System	See page 2B.

PERIODIC INSPECTION CHECKLIST

PROJECT [illegible] DATE [illegible]

PROJECT FEATURE Outlet - Civil/Structural NAME [illegible]

DISCIPLINE [illegible] NAME Sluter/Fodor

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	NOTE: Control Tower and Intake Structure are one unit.
a. Approach Channel	
Slope Conditions	Under water.
Bottom Conditions	[illegible] Boulders [illegible] left side of intake.
Rock Slides or Falls	None.
Log Boom	None.
Debris	None.
Condition of Concrete Lining	N.A.
Drains or Weep Holes	N.A.
b. Intake Structure	
Condition of Concrete	Badly spalled. No rebar exposed.
Stop Logs and Slots	None.

PERIODIC INSPECTION CHECKLIST

PROJECT [illegible] DATE [illegible]

PROJECT FEATURE Outlet NAME

DISCIPLINE Struct. Eng. NAME [illegible]

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Fair [illegible]
Condition of Joints	None.
Spalling	Entire surface is eroded.
Visible Reinforcing	[illegible]
Rusting or Staining of Concrete	Minor.
Any Seepage or Efflorescence	Efflorescence on left and right sides of downstream. No seepage observed.
Joint Alignment	N.A.
Unusual Seepage or Leaks in Gate Chamber	None observed.
Cracks	Concrete support slab for intake valves cracked all the way through.
Rusting or Corrosion of Steel	Trash rack is very corroded. [illegible]
b. Mechanical and Electrical	
Air Vents	N.A.
Float Wells	N.A.
Crane Hoist	N.A.
Elevator	N.A.
Hydraulic System	N.A.
Service Gates	Note operability of all valves as given by operator.
Emergency Gates	
Lightning Protection System	N.A.
Emergency Power System	N.A.
Wiring and Lighting System	[illegible]

PERIODIC INSPECTION CHECKLIST

PROJECT MYSTIC RESERVOIR SOUTH DATE Nov. 14, 19[illegible], Sept. 7, 19[illegible]

PROJECT FEATURE Outlet - Civil/Structural NAME Sluter/Foder

DISCIPLINE Geotechnical NAME Pedro Stelmar

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	Not visible.
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECKLIST

7 PROJECT MYSTIC RIVER, EA SOUTH DATE Nov. 17, 18, Dec. 7,

PROJECT FEATURE Outlet - Civil/Structural NAME Sluter

DISCIPLINE Geotechnical NAME Poulos Stetkar

	AREA EVALUATED	CONDITION
	OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	Water passes through a buried conduit to the water-supply pumphouse downstream. There is no significant discharge except during filter-washing operations. An old wheelhouse exists just downstream from the intake structure. This house is now used for storage and office space. The sump in the wheelhouse formerly contained water supply pipes and a water wheel. The discharge entered an arched tunnel that leads to a culvert under the road downstream, and subsequently to the spillway discharge channel. The comments below refer to this wheelhouse and the discharge channel.
	1 General Condition of Concrete	
	2 Rust or Staining	
	3 Spalling	
	4 Erosion or Cavitation	
	5 Visible Reinforcing	
	6 Any Seepage or Efflorescence	Clear seepage at 2-3 gpm from right wall of sump about 4 in. above floor. Also dampness about 4 ft above floor on right wall and 2 to 3 ft above floor on left side of upstream wall. Iron has rust stained the wall. Efflorescence around pipes where they enter from upstream wall.
	7 Condition at Joints	N/A
GEI	8 Drain Holes	N/A.
GEI	9 Channel	3' x 6' tailrace to South side of Jerry Browne Road.
GEI	10 Loose Rock or Trees Overhanging Channel	Trees on both sides downstream from road.
GEI	11 Condition of Discharge Channel	Satisfactory.

PERIODIC INSPECTION CHECKLIST

PROJECT [illegible] DATE [illegible]

PROJECT FEATURE Spillway - Civil/Structural NAME Sluter/Fodor

DISCIPLINE [illegible] NAME [illegible]

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	None.
Floor of Approach Channel	Under water. Bedrock may be seen just below surface on the left side.
b. Weir and Training Walls	
General Condition of Concrete	Fair.
Rust or Staining	Minor staining.
Spalling	Spalled along entire downstream face to 3 ft elevation above toe. A slush of what appears to have been applied seems to be the part that is spalling.
Any Visible Reinforcing	None.
Any Seepage or Efflorescence	Seepage along entire bedrock contact of weir to about 75 ft to right of concrete gravity dam. See page 2.
Drain Holes	N/A.
c. Discharge Channel	
General Condition	Service spillway - satisfactory. Emergency spillway - poor.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	Minor (two trees).
Floor of Channel	Good. Bedrock to 200 ft downstream then riprap. Minor brush.
Other Obstructions	One cast iron pipe about 16 ft [illegible] 4 in. diameter.
Other Comments	None.

PERIODIC INSPECTION CHECKLIST

PROJECT [illegible] DATE [illegible]

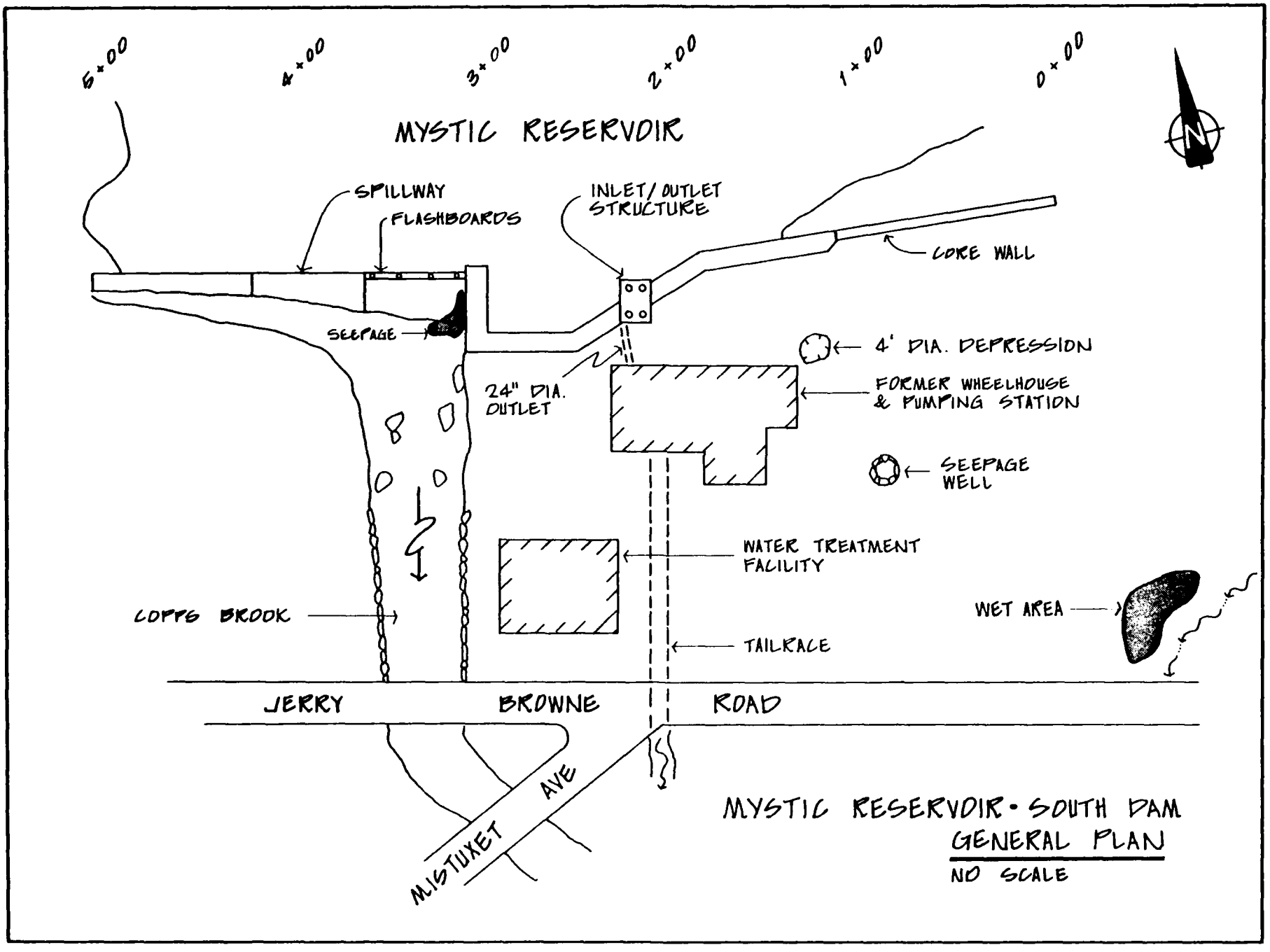
PROJECT FEATURE _____ NAME _____

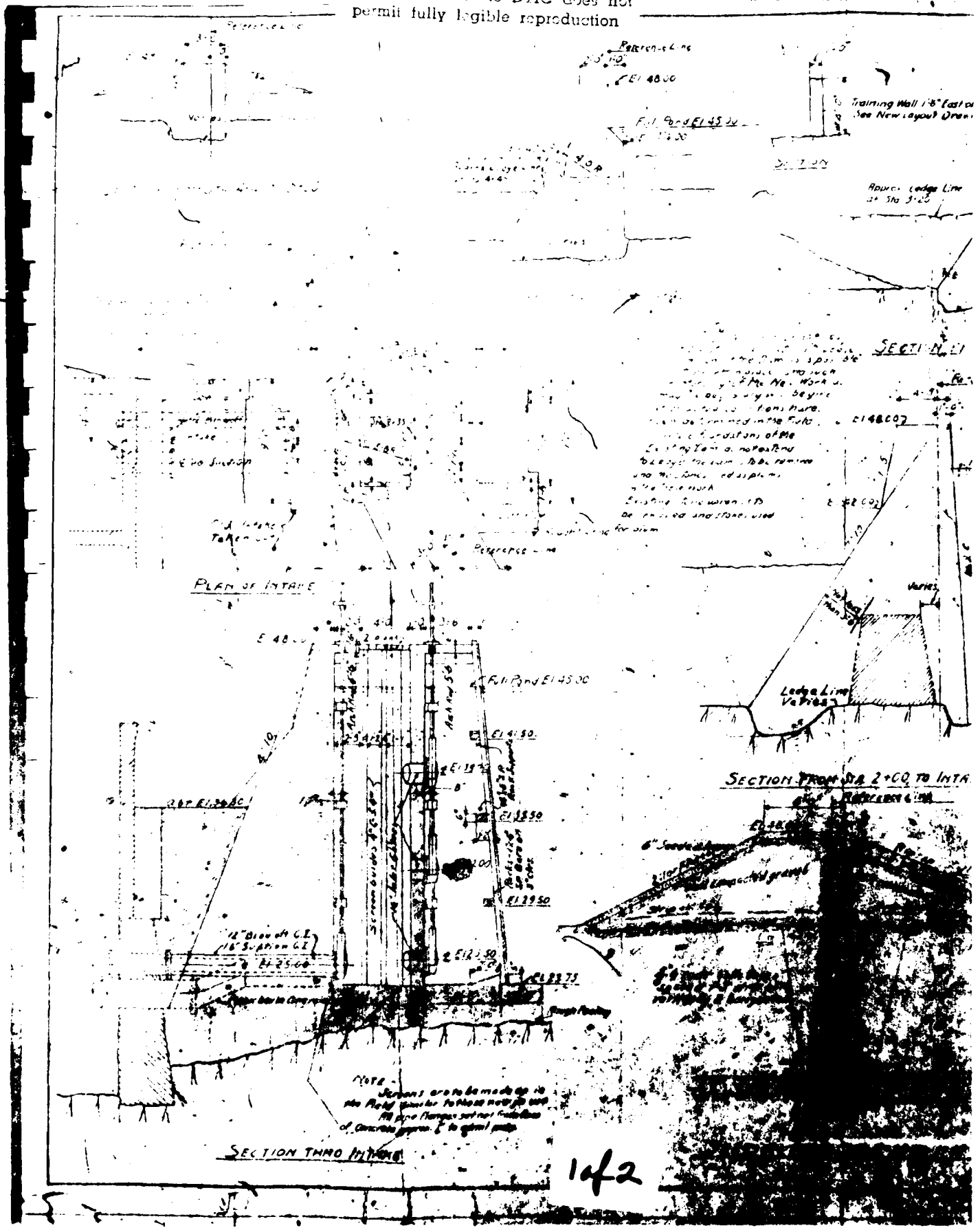
DISCIPLINE [illegible] NAME [illegible]

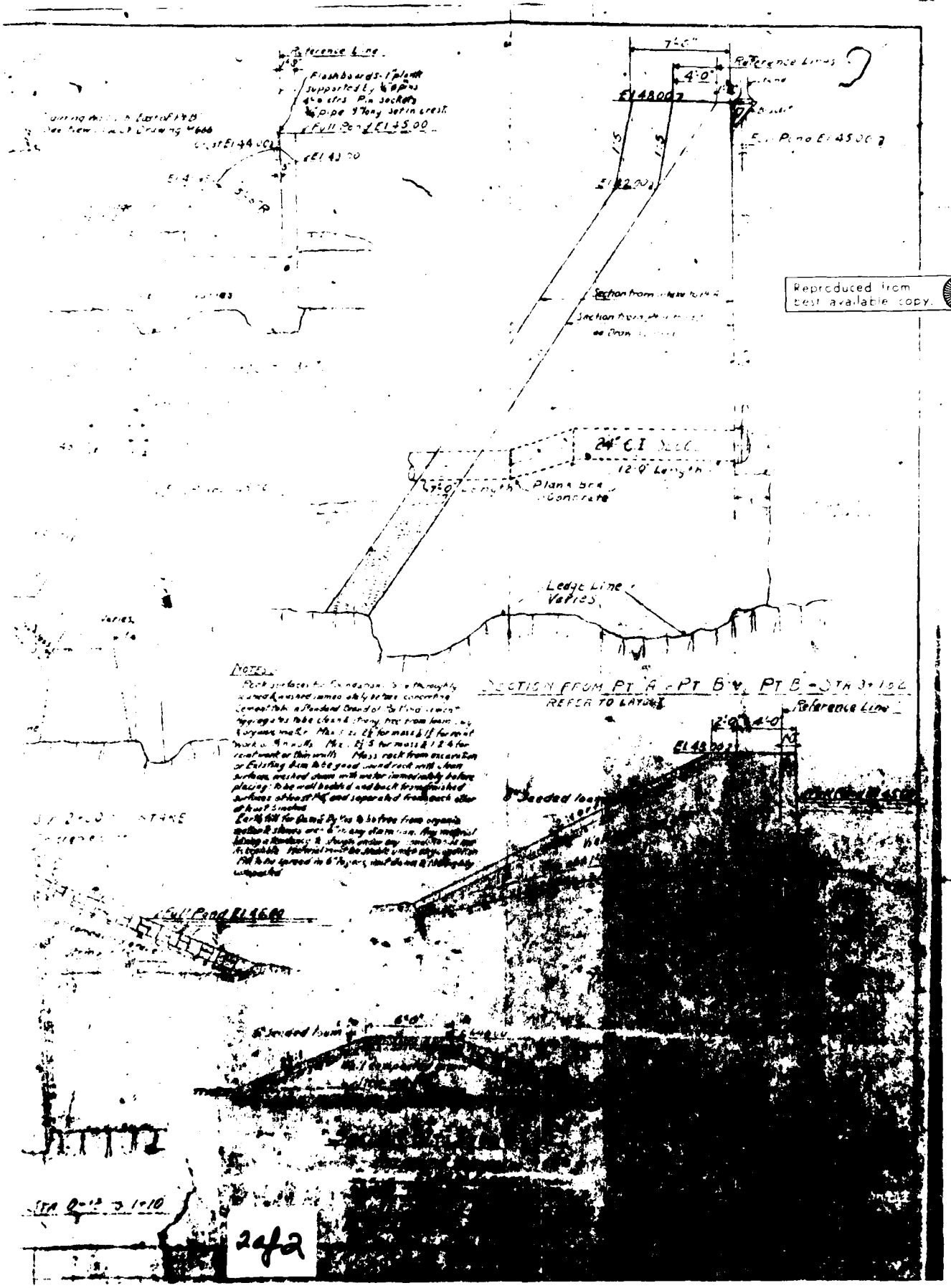
AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	None.
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Underside of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

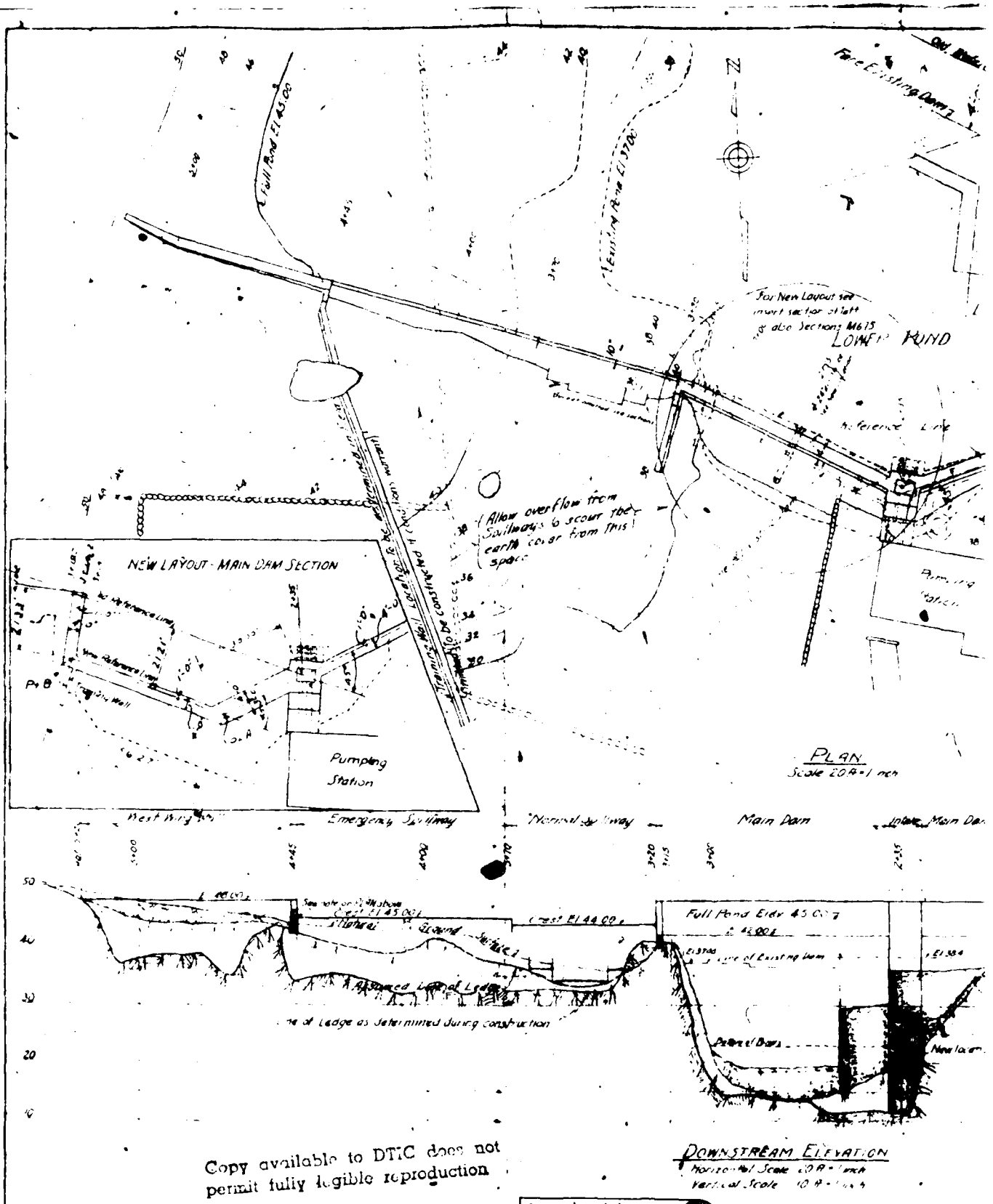
APPENDIX B

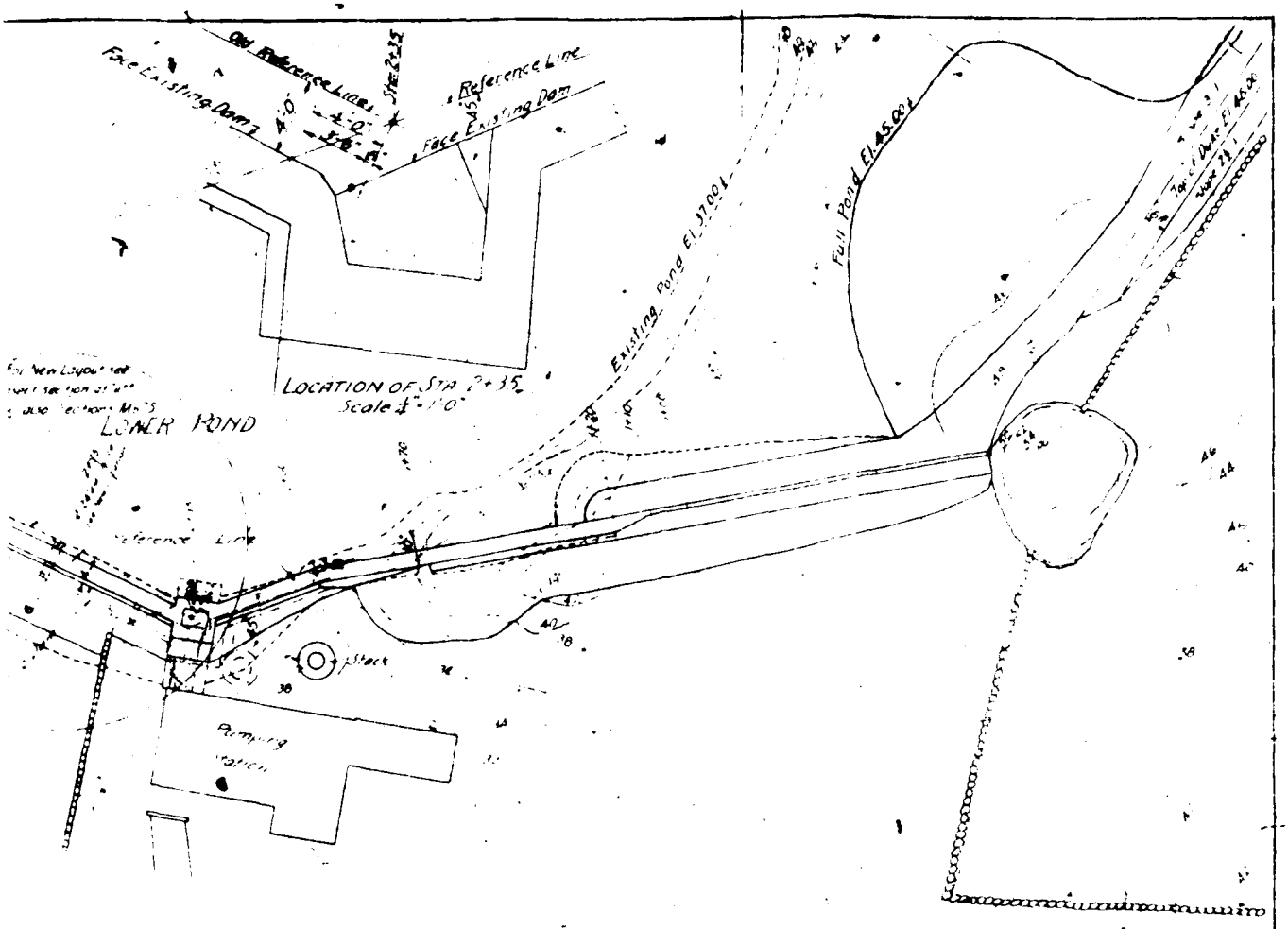
ENGINEERING DATA


5+00
4+00
3+00
2+00
1+00
0+00
MYSTIC RESERVOIR
N
SPILLWAY
FLASHBOARDS
INLET/OUTLET STRUCTURE
CORE WALL
SEEPAGE
4' DIA. DEPRESSION
24" DIA. OUTLET
FORMER WHEELHOUSE & PUMPING STATION
SEEPAGE WELL
WATER TREATMENT FACILITY
COPPS BROOK
WET AREA
TAILRACE
JERRY BROWNE ROAD
MISTUXET AVE
MYSTIC RESERVOIR - SOUTH DAM
GENERAL PLAN
NO SCALE

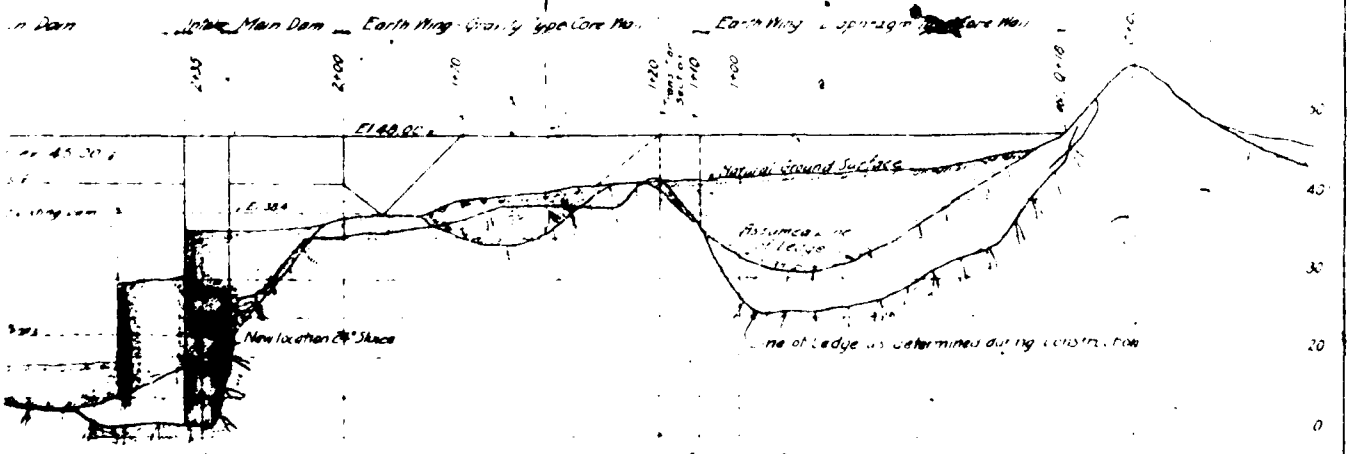








PLAN
Scale 20ft = 1 inch



FAM ELEVATION

REFERENCE DRAWINGS

S-665	PLAN OF FLOWAGE
M-667	TYPICAL SECTIONS OF DAM
M-[illegible]5	SECTIONS OF DAM AS CONSTRUCTED
	STONE RIP-RAP REINFORCEMENT

NO.	DATE	DESCRIPTION	BY
		CHANGES	

GEN. PLAN & ELEV. DAM LOWER POND
MYSTIC VALLEY WATER CO. STONINGTON, CONN.
CHASE & GILBERT INC. MANAGERS
VAUGHAN ENGINEERS
BOSTON, MASS.
Job No. 339 Checked Approved
May 6 1920
Scales as noted
M-666

CT 6135

3

Ch No. ____________

Inventoried By ____________

Date ____________

WATER RESOURCES COMMISSION
SUPERVISION OF DAMS
INVENTORY DATA

Name of Dam or Pond: Mystic Reservoir (South) Palmer Res. Sorry

Code No.: QG-101 CP 0.8

Nearest Street Location: Jerry Brown Rd

Town: Stonington LAT. 41°21.9

U.S.G.S. Quad.: Mystic LONG. 71°56.1' 7/73

Name of Stream: Copps Br

Owner: Mystic Valley Water Co.

Address: 1 Pearl St.
Mystic

Pond Used For: Supply DA 6.395M

Dimensions of Pond: Width ____ Length - Area 20ac

Total Length of Dam: 300' Length of Spillway

Location of Spillway: left

1900?

Height of Pond Above Stream Bed: 8' 12.5ft w/splashboard 7.3

Height of Embankment Above Spillway: 2'

Type of Spillway Construction: sloping Conc.

Type of Dike Construction: fill & conc

Downstream Conditions: road woods

Summary of File Data ____________

Remarks ____________

Would Failure Cause Damage? ____________ Class B

REPORT TO
MYSTIC VALLEY DISTRICT
CONNECTICUT–AMERICAN WATER COMPANY
UPON
LEAKAGE, STRUCTURAL
AND HYDROLOGIC INVESTIGATIONS
AT PALMER DAM

June 9, 1978

METCALF & EDDY, INC. / ENGINEERS
BOSTON · NEW YORK · PALO ALTO · CHICAGO

50 Stanhope Street Boston Massachusetts 02116
617 367-4600 TWX 710 321-4066 Cable Address METEDDY BSTN

Engineers & Planners

June 9, 1978

Mr. David Kanke
District Manager
Mystic Valley District
Connecticut - American Water Company
Toy House Building
Whitehall Avenue
Mystic, Connecticut 06355

Dear Mr. Kanke:

In accordance with our Agreement dated November 21, 1977, we have completed an investigation of Palmer Dam.

Our report describing the investigation and recommended repairs is submitted herewith.

Very truly yours,

METCALF & EDDY, INC.

Stephen L. Bishop

Stephen L. Bishop
Vice President

APPENDIX C

PHOTOGRAPHS

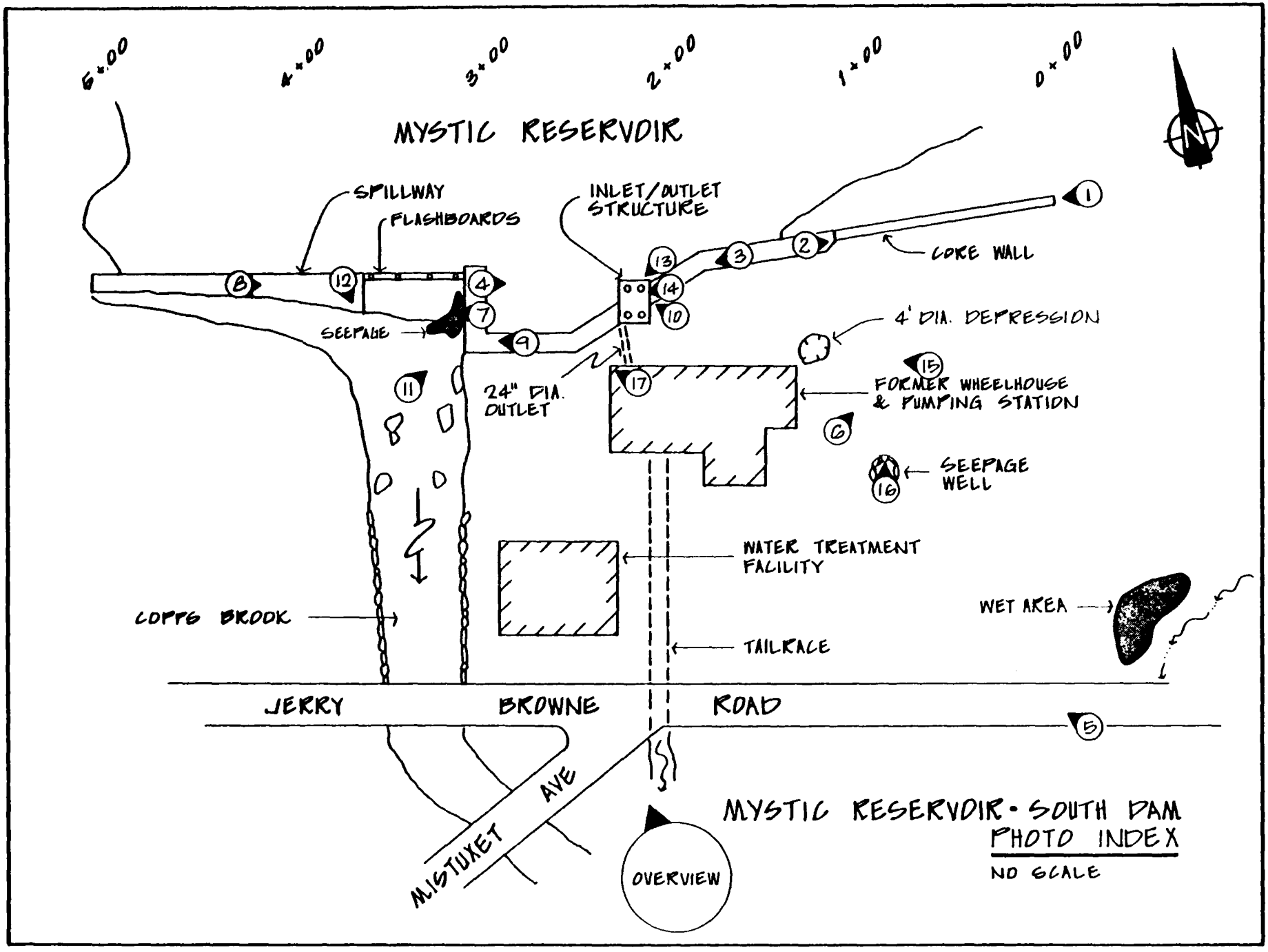

6+00
4+00
3+00
2+00
1+00
0+00
MYSTIC RESERVOIR
SPILLWAY
FLASHBOARDS
INLET/OUTLET STRUCTURE
CORE WALL
SEEPAGE
4' DIA. DEPRESSION
24" DIA. OUTLET
FORMER WHEELHOUSE & PUMPING STATION
SEEPAGE WELL
WATER TREATMENT FACILITY
COPPS BROOK
WET AREA
TAILRACE
JERRY BROWNE ROAD
MISTUXET AVE
OVERVIEW
MYSTIC RESERVOIR - SOUTH DAM
PHOTO INDEX
NO SCALE

PHOTO C-1: Dam crest and downstream face from the left abutment.

PHOTO C-2: Left abutment and dam crest.

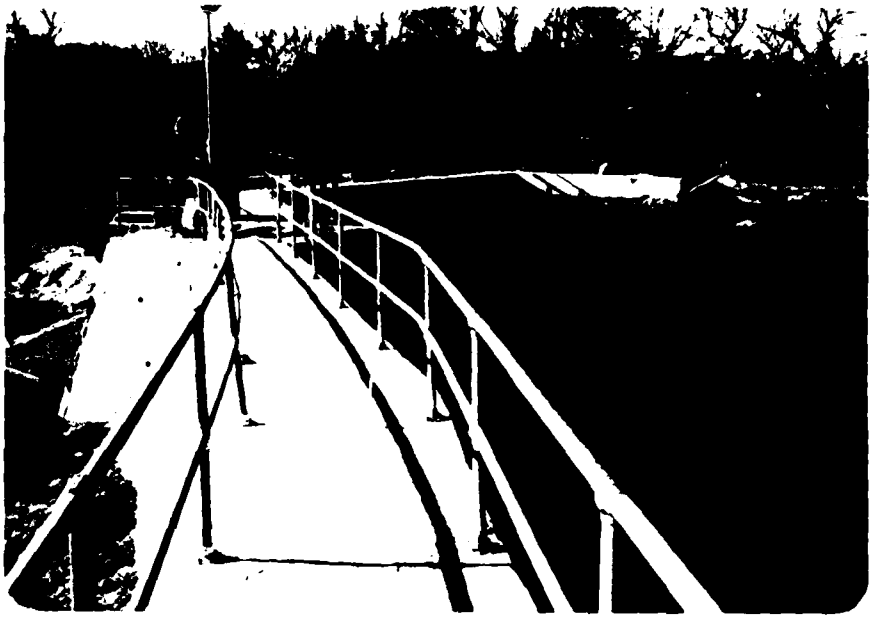


PHOTO C-3: Upstream face, crest and intake structure looking towards right abutment.

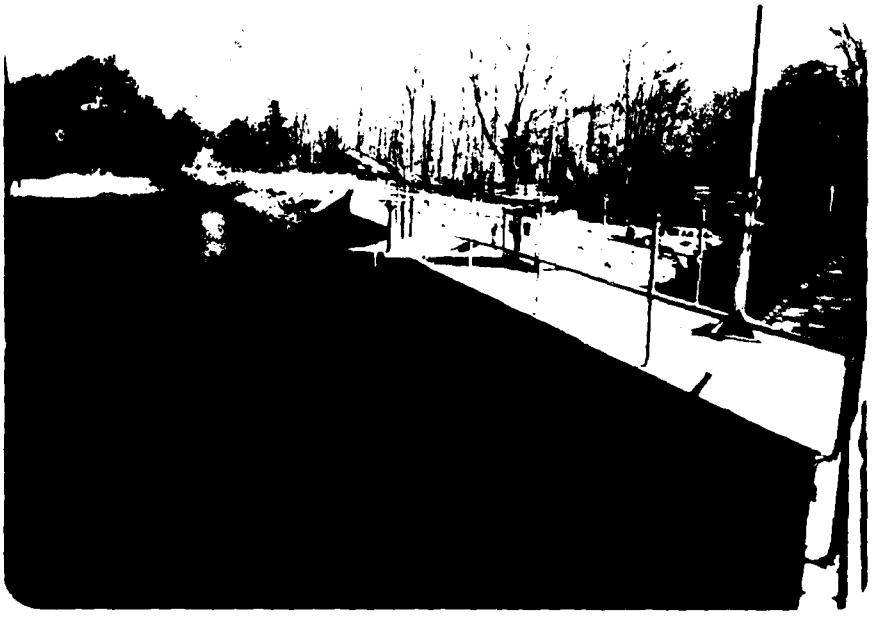


PHOTO C-4: Upstream face and left abutment.

PHOTO C-5: Downstream view of the dam showing water treatment facility located at the toe.

PHOTO C-6: Downstream face of the earth embankment section. Note numerous tree stumps on slope.

PHOTO C-7: Downstream face and toe of spillway from the left spillway abutment. Note cracking and spalling of the concrete and seepage at the toe.

PHOTO C-8: Spillway crest from the right abutment showing constriction of spillway discharge channel by natural ground.

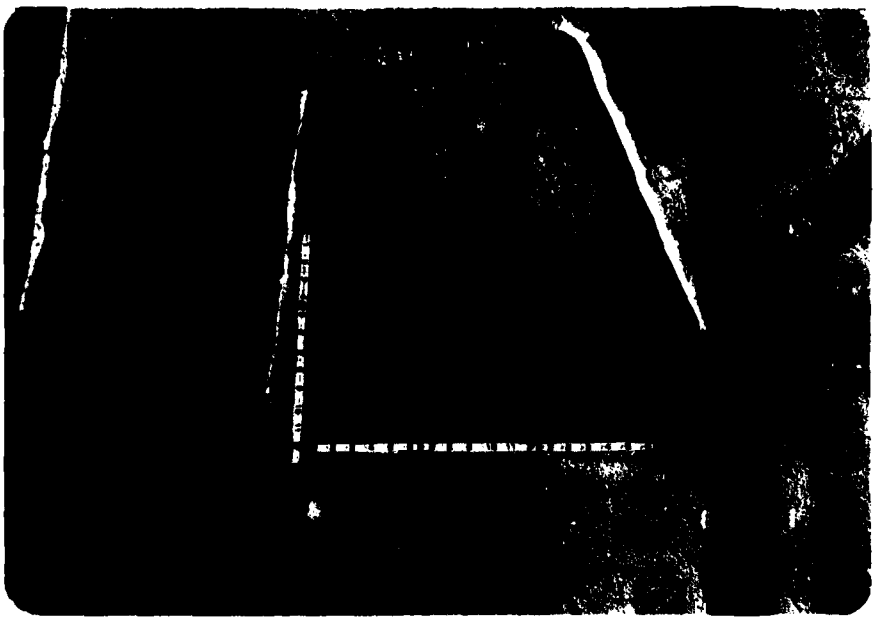


PHOTO C-9: Crack in dam crest through construction joint at station 2+95.

PHOTO C-10: Downstream face of gravity section. Note cracking and efflorescence of concrete.

PHOTO C-11: Downstream face of gravity section at the left spillway abutment. Note the seepage and cracking and spalling of concrete near the left spillway abutment.

PHOTO C-12: Downstream channel viewed from the spillway crest.

PHOTO C-13: Badly rusted trash rack on intake structure. Also note cracking and spalling of concrete.

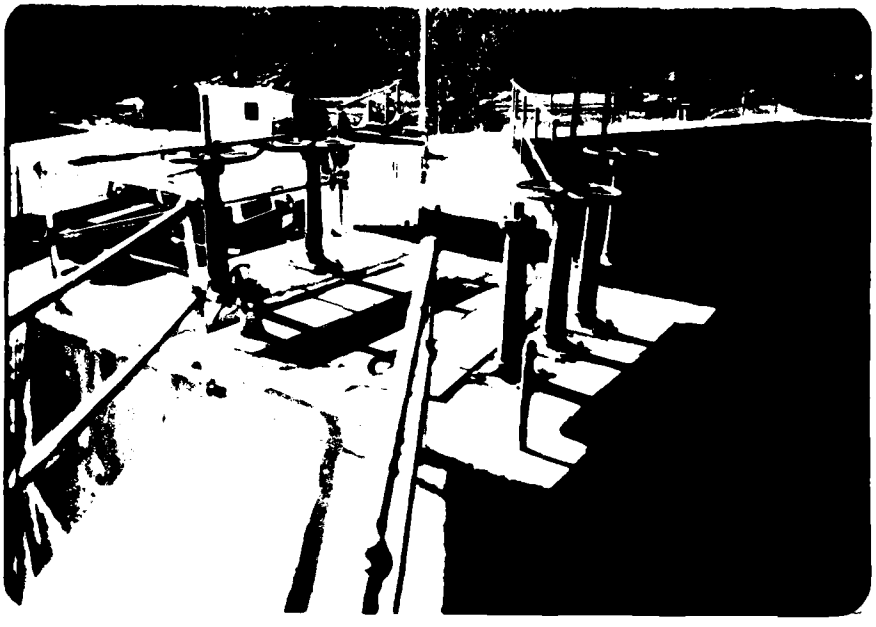


PHOTO C-14: Intake structure and gate mechanisms near the centerline of the dam.

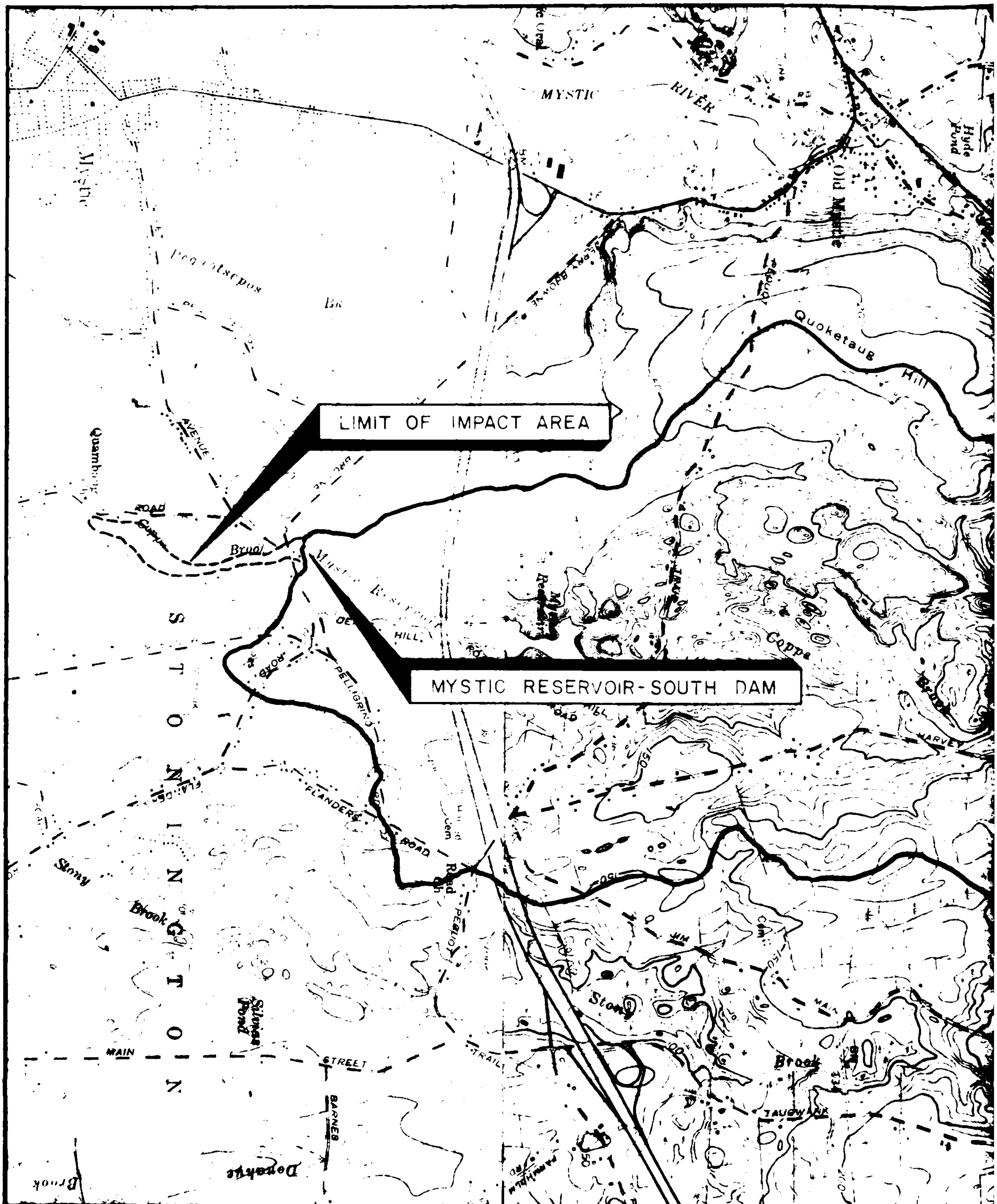
PHOTO C-15: Depression and lush growth of grass on downstream toe at Station 1+30.

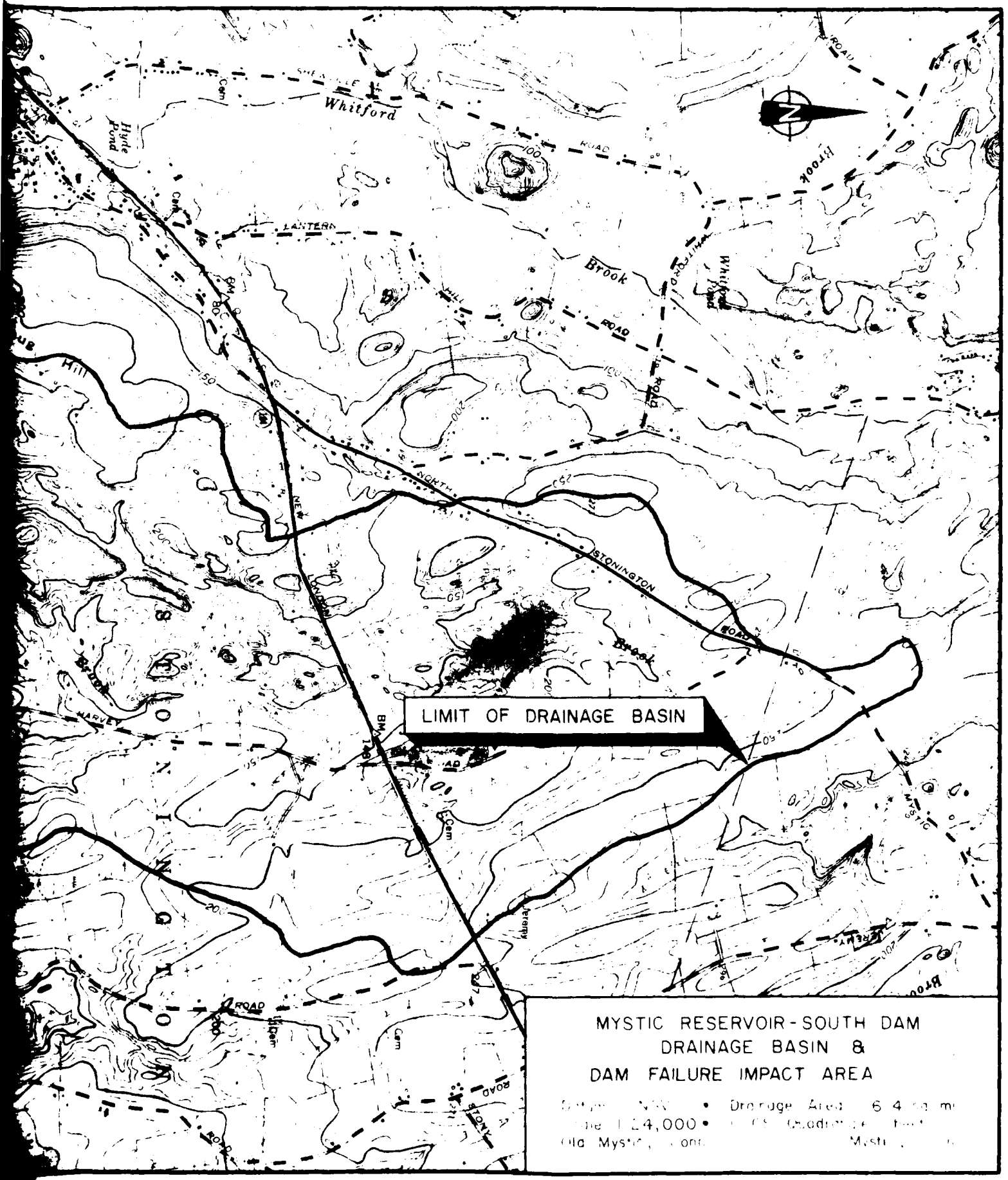
PHOTO C-16: Close-up of seepage in bottom of spring box on downstream toe at Station 1+15.

PHOTO C-17: Seepage through the wall of the sump below the wheelhouse.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS


LIMIT OF IMPACT AREA
MYSTIC RESERVOIR-SOUTH DAM
MYSTIC RIVER
Mystic
Quoketaug Hill
Old Mystic
Hyde Pond
S T O N I N G T O N
Stony Brook
Main Street
Flanders Road
Pequot Trail
Silvias Pond
Copps Brook
Harvey
Taugwank
Barnes
Avenue
Road
Pequotsepos Bk


Whitford
Hyde Pond
LANTERN
Brook
ROAD
STONINGTON
Brook
LIMIT OF DRAINAGE BASIN
MYSTIC RESERVOIR - SOUTH DAM
DRAINAGE BASIN &
DAM FAILURE IMPACT AREA

[illegible]

DRAINAGE AREA = 6.4 SQ. MI.
SPILLWAY POOL ELEV. = 45.0 (W/ FLASHBOARDS) NGVD
= 44.0 (W/O FLASHBOARDS)
MAX POOL ELEV. = 48.0 NGVD.

RESERVOIR

@ SPILLWAY POOL - AREA = 25 ACRES
STORAGE = 250 AC-FT

@ MAX. POOL - AREA = 25 AC
STORAGE = 250 AC-FT

DAM : CONCRETE GRAVITY & EARTHFILL W/CONCRETE [illegible]

MAX. HEIGHT = 34 FT.
LENGTH = 500 FT.

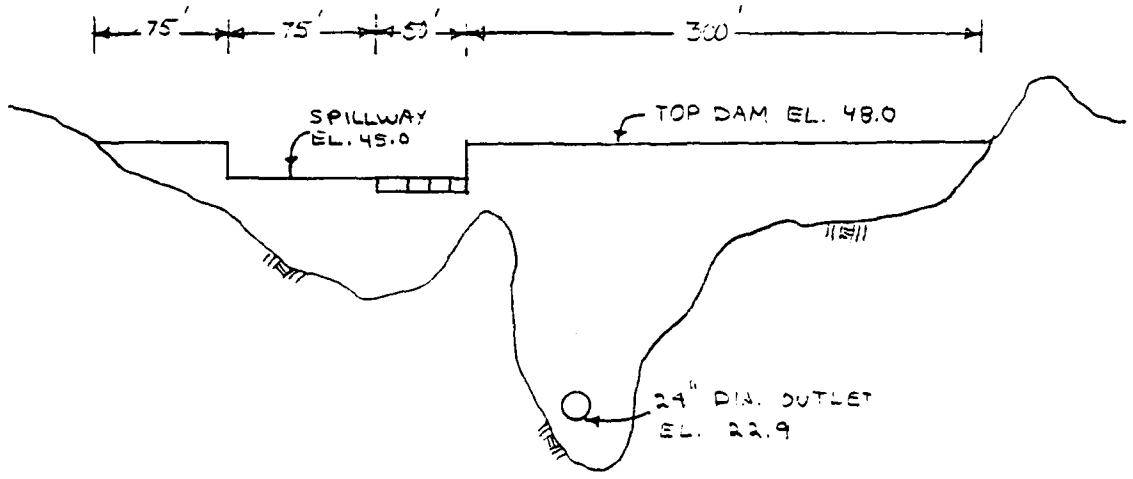
SPILLWAY : CONCRETE OGEE, FREE OVERFLOW [illegible]

CREST = 44.0 NGVD (SECT @ W/ FLASH.) L= 50 FT
= 45.0 NGVD (SECT @ W/O FLASH.) L= 75 FT

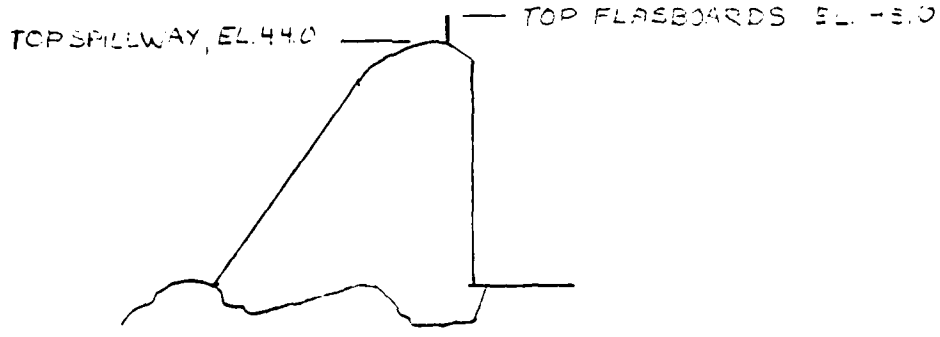
OUTLET : 24 INCH DIA. CAST IRON PIPE

INVERT = 22.9 NGVD.

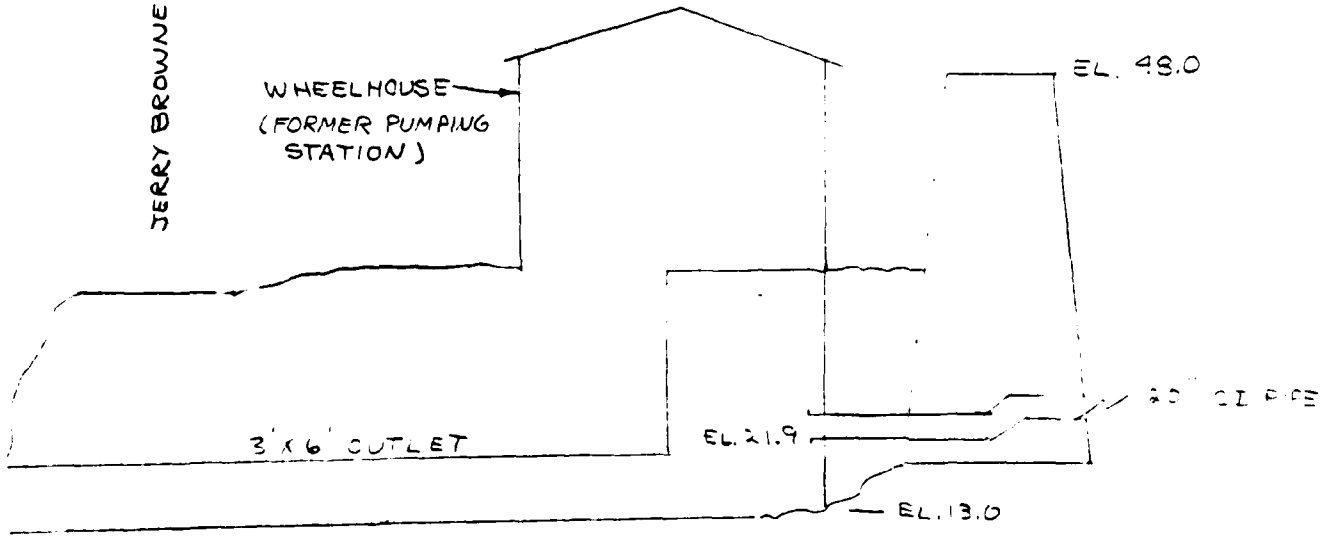
GATE : MANUAL VERTICAL LIFT



LONGITUDINAL SECTION ALONG DAM - LOOKING UPSTREAM



SPILLWAY SECTION



CALCULATE TEST FLOOD

CLASSIFICATION : SMALL
HAZZARD : SIGNIFICANT

USE : 1/2 PMF BASIN SLOPE : FLAT → ROLLING

FROM PMF CURVE @ DA = 6.4 SQ. MI. , PMF = 1250 CSM

REDUCE BY 10% FOR STORAGE = .9 x 1250 = 1125 CSM

PMF = 1125 x 6.4 = 7,200 CFS

1/2 PMF = 3600 CFS

CALCULATE DAM RATING CURVE

DAM & SPILLWAY $Q = CLH^{3/2}$

DAM C = 2.6 = BROADCRESTED WEIR L = 375'

SPILLWAY C = 3.9

L = 50' (MAIN) (ASSUME FLASHBOARDS REMOVED)
= 75' (EMERG.)

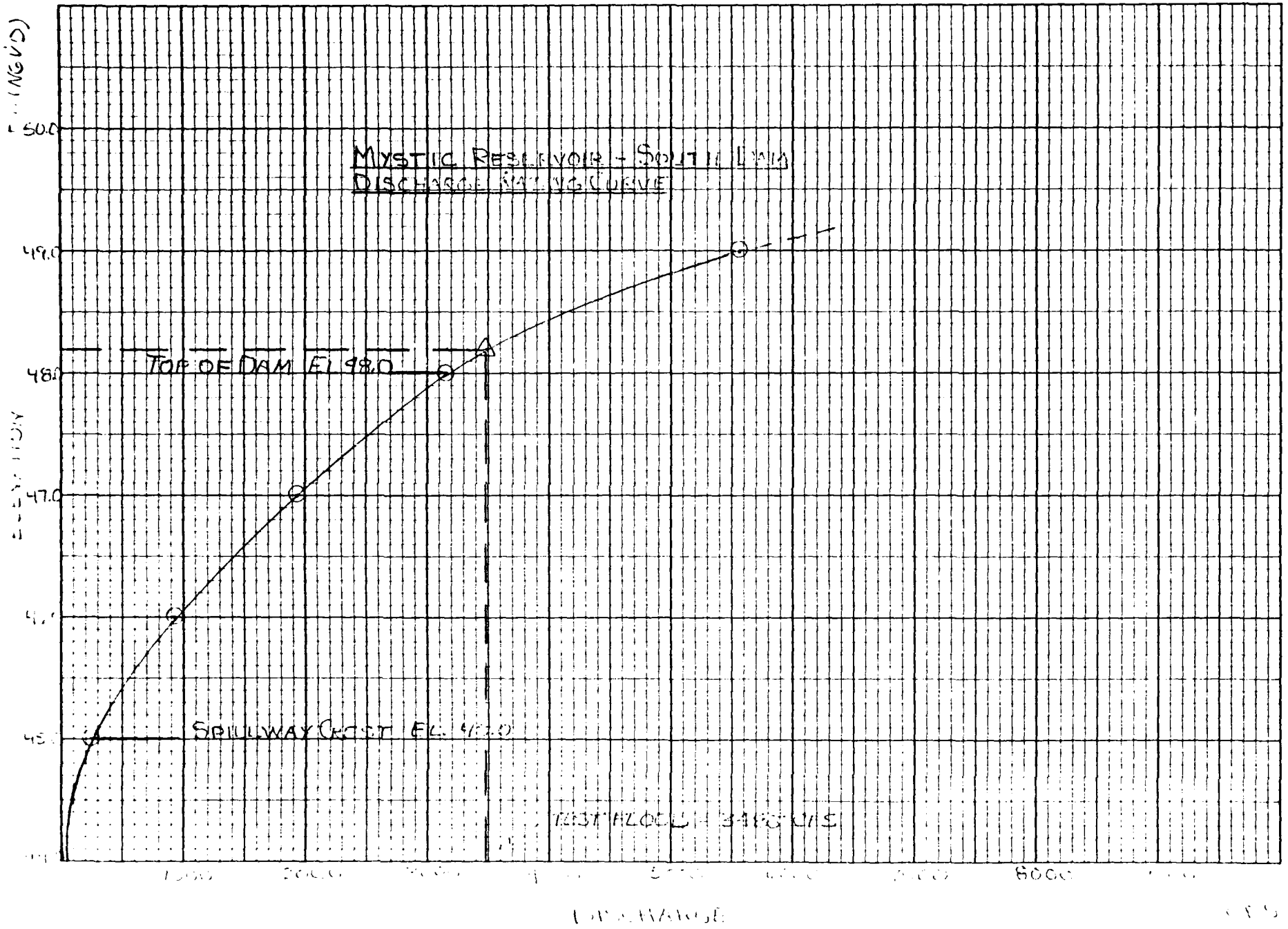
OUTLET $Q = CA\sqrt{2gH}$ C = 0.6 A = 3.14 SQ FT

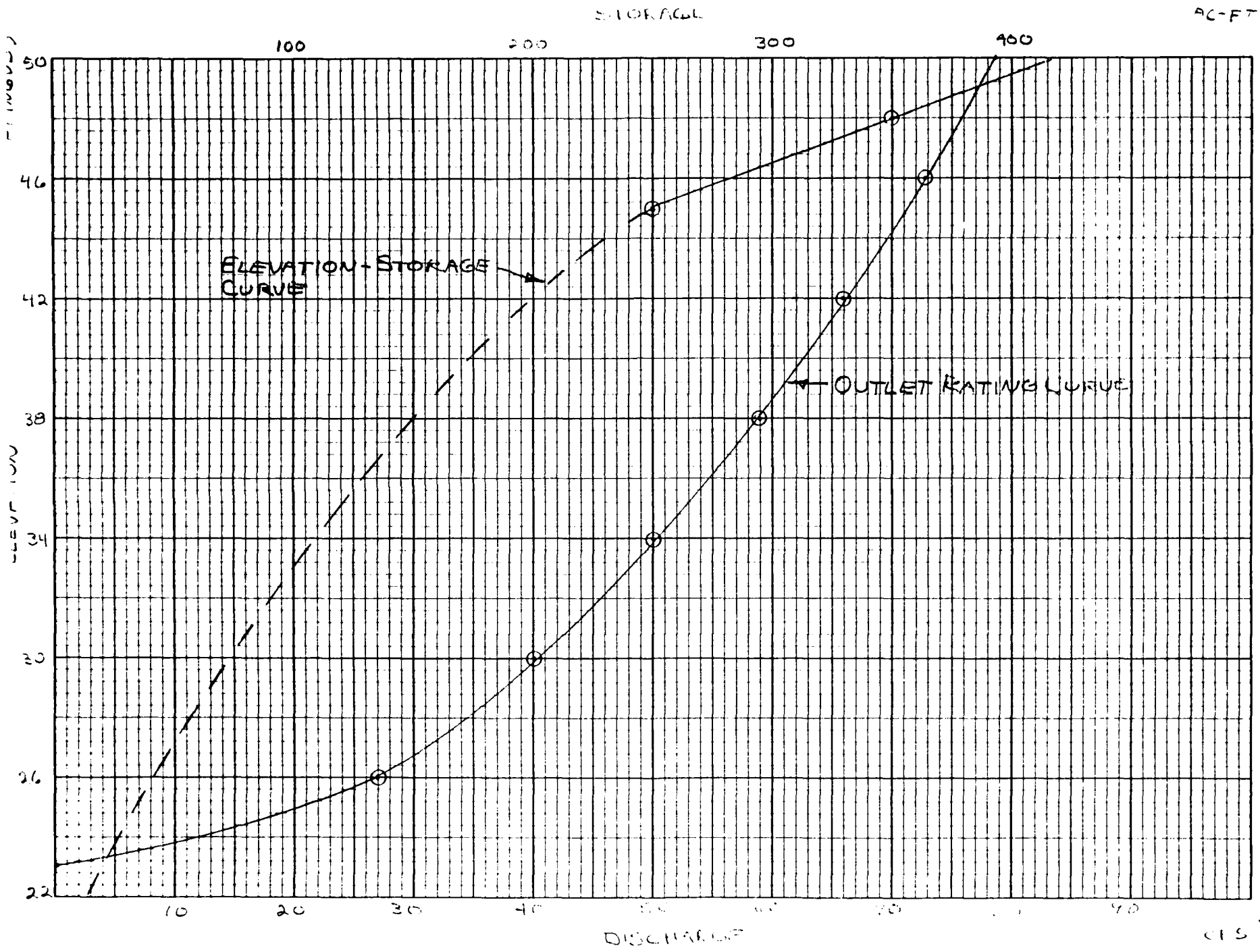
H MEAS. FROM ℄ OUTLET

ELEV.	$H_{SPILL(MAIN)}$	Q	H_{DAM}	Q	H_{OUT}	Q	H_{EMERG}	Q	ΣQ
45.0	1.0	195	-	-	22.1	70	-		265
46.0	2.0	550	-	-	23.1	70	1.0	290	910
47.0	3.0	1015	-	-	24.1	75	2.0	830	1920
48.0	4.0	1560	-	-	25.1	75	3.0	1520	3155
49.0	5.0	2180	1.0	975	26.1	80	4.0	2340	5575

@ TOP DAM = 48.0
SPILLWAY CAPACITY = 3080 CFS
OUTLET CAPACITY = 75 CFS
3155 CFS

@ TEST FLOOD = 48.2
SPILLWAY CAPACITY = 3350 CFS
OUTLET CAPACITY = 80 CFS


MYSTIC RESERVOIR - SOUTH LAKE
DISCHARGE RATING CURVE
TOP OF DAM EL 98.0
SPILLWAY CREST EL. 92.0
50.0
49.0
48.0
47.0


STORAGE
AC-FT
100
200
300
400
50
46
42
38
34
30
26
22
ELEVATION
ELEVATION - STORAGE CURVE
OUTLET RATING CURVE
10
20
30
40
70
DISCHARGE
CFS

CALCULATE EFFECT OF SURCHARGE STORAGE

PEAK INFLOW = 3600 CFS → SURCHARGE = 4.2 FT

$V_1 = \frac{4.2 \times 254 \text{ AC} \times 12 \text{ IN/FT}}{6.4 \times 640} = .31 \text{ IN}$

$Q_{P_1} = \left(\frac{1 - .31}{9.5}\right) 3600 = 3485 \text{ CFS} \rightarrow \text{STAGE} = 4.2 \text{ FT}$

$\therefore \quad Q = \underline{3485}$, ELEV. = $\underline{48.2 \text{ FT}}$ NGVD.

1. STORAGE WILL REDUCE THE TEST FLOOD [illegible] BY 115 CFS OR 3 %
2. THE SPILLWAY CAN PASS 3480 CFS OR 86 % OF THE TEST FLOOD
3. AT THE PEAK [illegible] CFS THE DAM WILL BE OVERTOPPED BY 0.2 FEET

DAM FAILURE ANALYSIS

DAM FAILURE $Q = 8/27 \, W_B \sqrt{g} \, Y_0^{1.5}$ $\quad Y_0 = 34$ FT.

USE W_B = 40 % OF DAM LENGTH @ MID HEIGHT = [illegible] FT

$Q_{FAIL} = 8/27 \, (36) \sqrt{32.2} \, 34^{1.5}$

$= 12{,}000$ CFS

$+ \underline{2500 \text{ CFS}}$ (SPILLWAY Q)

TOTAL $Q_{FAIL} = 14{,}500$ CFS

ESTIMATE DOWNSTREAM IMPACT

REACH 1 $\quad L = 3300$

TYPICAL SECTION $\quad$ 15' $\quad$ $n = 0.05$

$S_f = 0.005$

ESTABLISH RATING CURVE FOR REACH $\quad Q = \frac{1.486}{n} A R^{2/3} S_f^{1/2}$

STAGE	A	$R^{2/3}$	Q
2	82	1.14	200
4	268	1.72	970
6	558	2.20	2575
8	952	2.63	5260
10	1450	3.03	9220
12	2052	3.40	14650

② Q = 14,500 STAGE = 12 FT, AREA = 2052

$STOR_1 = \frac{3800 \times 2052}{43560} = 179$ AC-FT > .5 x 350 ∴ USE SHORTER REACH

REACH L = 1900 FT

$STOR_1 = \frac{1900 \times 2052}{43560} = 89.5$ AC-FT

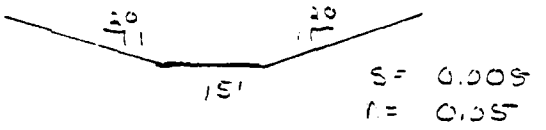
$Q_{P_1} = \left(1 - \frac{89.5}{350}\right) 14,500 = 10,800$ CFS → STAGE = 11.5 FT
AREA = 1600 SQ. FT.

$STOR_2 = \frac{1600 \times 1900}{43560} = 70$ AC-FT $STOR_{AVG} = \frac{89.5 + 70}{2} = 79.75$

$Q_{P_2} = \left(1 - \frac{79.75}{350}\right) 14,500 = 11,200$ CFS STAGE = 11 FT

REACH 2 L = 1900 FT

STAGE	A	$R^{2/3}$	Q
4	380	1.68	1340
6	810	2.16	3675
8	1400	2.59	7630
10	2150	2.99	13524



S = 0.005
n = 0.05
TYPICAL SECTION

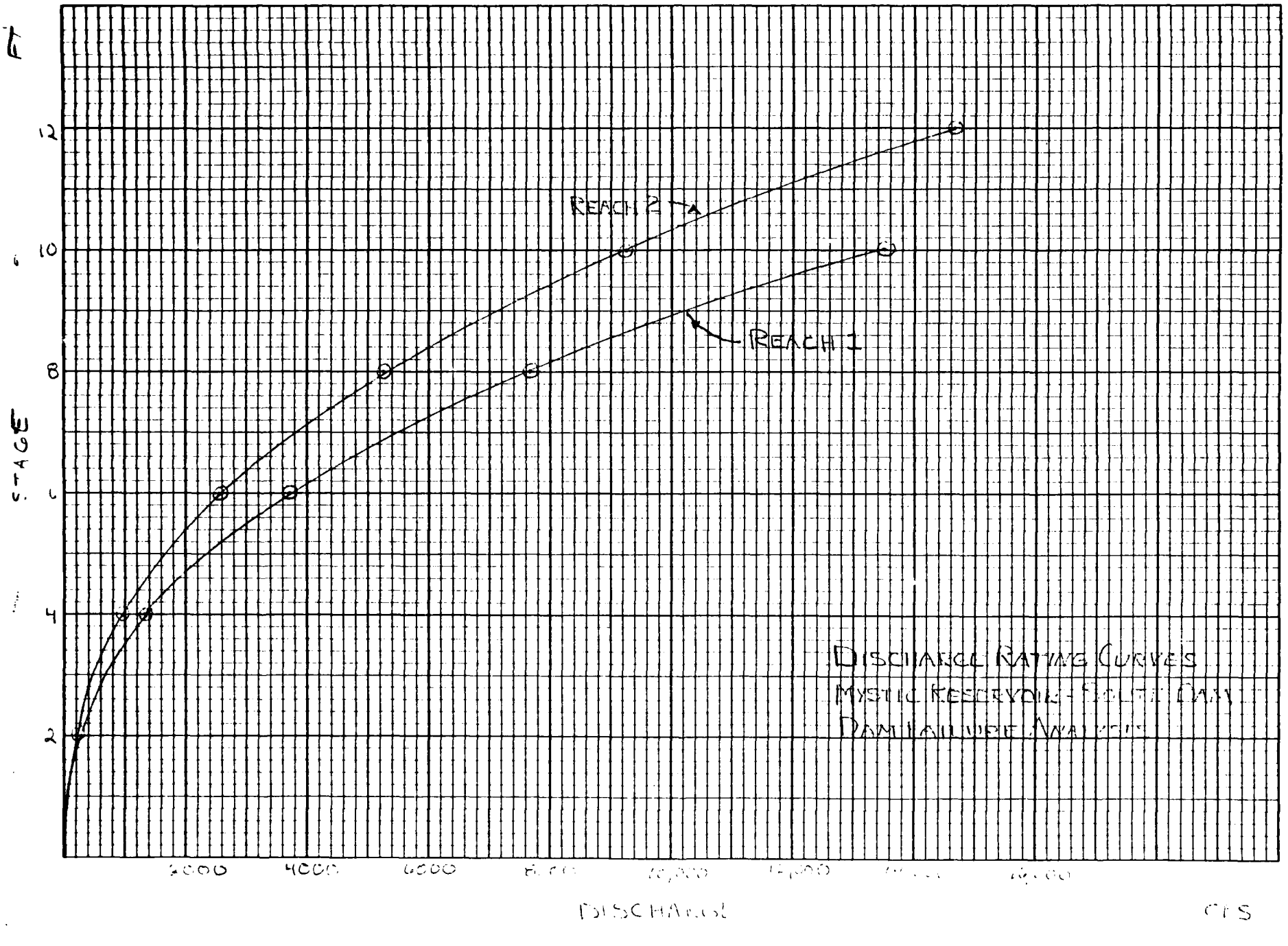
@ Q = 11,600 CFS STAGE = 9.5 AREA = 1900

$STOR_1 = \frac{1900 \times 1900}{43560} = 83$ AC-FT

$Q_{P_1} = \left(1 - \frac{83}{350}\right) 11,200 = 8550$ → STAGE = 8.5 FT A = 1550

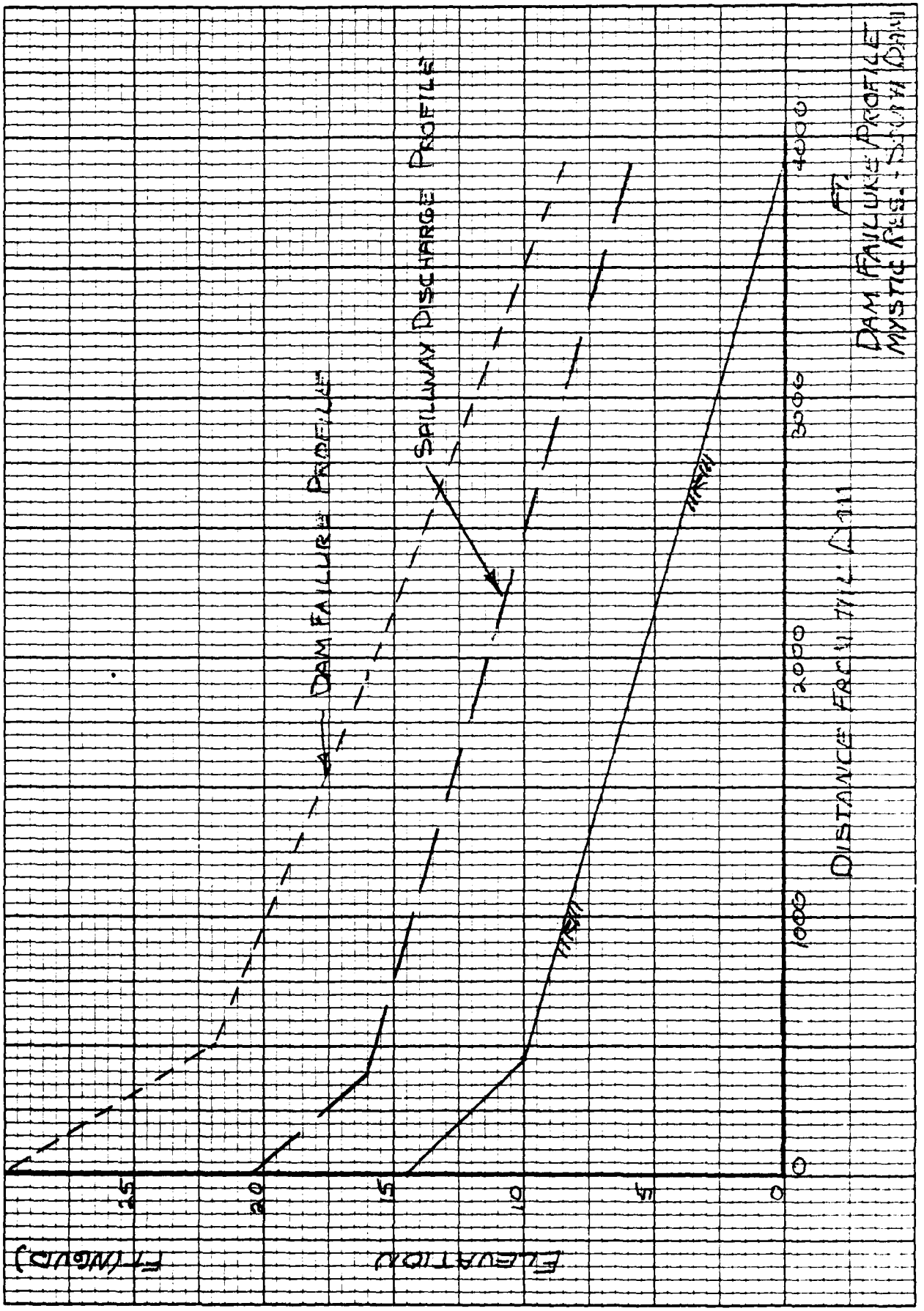
$STOR_2 = \frac{1550 \times 1900}{43560} = 68$ AC-FT $STOR_{AVG} = \frac{68 + 83}{2} = 75.5$

$Q_{P_2} = \left(1 - \frac{75.5}{350}\right) 11200 = 8800$ CFS STAGE = 8.5 FT.



DISCHARGE RATING CURVES
MYSTIC RESERVOIR - POLETT DAM
POWDER RIVER BASIN

8/9


DAM FAILURE PROFILE
SPILLWAY DISCHARGE PROFILE
ELEVATION
FT (MSL)
DISTANCE FROM DAM - FT
MYSTIC LAKE - MONTANA
DAM FAILURE PROFILE
0
1000
2000
3000
4000
5
0
-5
-20
-25

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY	MO	YR
CT	413	NED	CT	011	02			MYSTIC RESERVOIR DAM	4121.9	7156.1		20	OCT80

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
PALMER RESERVOIR	MYSTIC RESERVOIR

(15) REGION/BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	(19) DIST FROM DAM (MI)	(20) POPULATION
01 10	COPES BROOK	STONINGTON	0	17000

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT)	(25) HYDRAULIC HEIGHT (FT)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT)	(27) NORMAL (ACRE-FT)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
CT-EMB	1900	S	21	18	180	150	NED	N	N	N	N	

(28) REMARKS

(29) DAMS IMPOUNDED	(30) SPILLWAY TYPE	WIDTH (FT)	(31) MAXIMUM DISCHARGE (CFS)	(32) VOLUME OF DAM (CY)	(33) POWER CAPACITY INSTALLED (MW)	PROPOSED (MW)	(34) NAVIGATION LOCKS NO	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)
1	[illegible]	100	707	5830											

(41) OWNER	(42) ENGINEERING BY	(43) CONSTRUCTION BY
MYSTIC VALLEY WATER CO		

(44) REGULATORY AGENCY

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
		CT DEP	CT DEP

(45) INSPECTION BY	INSPECTION DATE DAY	MO	YR	(46) AUTHORITY FOR INSPECTION

(47) REMARKS

ST=ST ESTIMATE FED=ST ESTIMATE

END

DATE
FILMED

84

DTIC